Popular Astronomy

Vol. XL, No. 4 APRIL, 1932 Whole No. 394

The Forty-Seventh Meeting of the American Astronomical Society

By DEAN B. McLAUGHLIN

On invitation of the Superintendent and staff of the United States Naval Observatory, the American Astronomical Society convened in Washington for its forty-seventh meeting, Monday to Wednesday of the week following Christmas. The attendance was unusually large, one hundred and one members and fifty-eight guests being recorded. Headquarters of the Society were located at the Ambassador Hotel, where most of the visiting members took up their abode for three days in comfortable surroundings.

A meeting of the Council was held each morning at the Ambassador Hotel, and weighty problems were discussed and solved. The Council elected fourteen new members of the Society.

Four sessions for papers were held in the lecture hall of the Carnegie Institution of Washington. The use of this hall was a courtesy which the Society greatly appreciates. The Institution is located within easy walking distance of the hotel, but at times of heavy traffic the term "easy" applied in a purely relative sense.

In the absence of President Adams, the chair was occupied by Vice-President Abbot, who was sometimes relieved by F. B. Littell. At the opening session, on Monday morning, Captain J. F. Hellweg, Superintendent of the Naval Observatory, welcomed the Society and expressed the hope that Washington would live up to its reputation for sunny skies,—a hope that was fulfilled on the following day.

The retiring Presidential Address, "Observation and Gravitational Theory in the Solar System," was delivered by Dr. Ernest W. Brown at the Tuesday morning session. In the course of the four sessions, Monday morning and afternoon and Tuesday and Wednesday mornings, thirty-three papers were presented and one read by title. A short summary of the papers, or *abstract of the abstracts,* will be given near the end of this account of the meeting. The abstracts themselves will appear in the *Publications* of the Society, Volume 7, No. 3.

On Monday evening the members of the Society and others attending the meeting were the guests of the Naval Observatory staff at a most enjoyable reception held at the Observatory. Many availed themselves of the opportunity to make a tour of inspection. Undoubtedly the library with its palms and its fountain was the most attractive spot. The reception also afforded an opportunity to meet and talk with others

in a more leisurely fashion than had been possible earlier in the day. There was great interest in the 40-inch mirror which was only part way through the rough-grinding stage, and which is being shaped under the direction of Dr. Ritchey. Later in the evening refreshments were served,—very appropriately in the office of the Maintenance Division.

Tuesday afternoon, when no event was scheduled on the regular program, many of the members visited the Bureau of Standards and brought all work in the spectroscopic and optical sections to a standstill. The large new quartz spectrograph, the grating spectrograph, and the machines for testing instruments and graduating circles were centers of interest. At the end of the visit some members found their way by devious courses to the shop where optical glass was being made. Those who did not visit the Bureau doubtless spent Tuesday afternoon seeing the sights of Washington.

The dinner was held at the Ambassador Hotel at seven o'clock Tuesday evening. Vice-President Abbot, as toastmaster, won distinction for himself by singing nautical ditties between speeches. He called in turn upon Captain Hellweg, Slocum, Curtis, Russell, and Stetson for contributions to the entertainment. These contented themselves with telling their stories instead of singing them, but the flavor of the sea was strong in most of them. It is suspected that a few were ever so slightly exaggerated.

After the speeches a considerable fraction of the party repaired to the ballroom where, failing at first to persuade the radio to furnish dance music, they took part in a Virginia reel, under the able direction of Miss Swope. Some who did not take part in the contest remained on the sidelines and furnished moral support. The radio finally had a change of heart, and the Virginia reel was followed by dancing.

The program of papers presented considerable variety. Individual bodies of the Solar System received scant attention. Bobrovnikoff outlined plans for a general catalogue of comets, Eckert reported on the general orbit of the asteroid Hector, and meteor spectra were discussed in a paper by Millman. In theoretical astronomy, a paper by Smiley, and one by him, with Miss Whittemore, dealt with methods of orbit calculation. Mrs. Lewis, from data on fourteen eclipses, showed that Oppolzer's predictions are more accurate than is generally believed. Father McNally described rapid methods of making approximate predictions of occultations.

Fundamental astronomy was represented by two papers. C. H. Swick of the Coast and Geodetic Survey described plans for re-opening the Gaithersburg latitude station, and H. R. Morgan presented the results of a discussion of many transit observations, yielding a small correction to Newcomb's equinox.

Ross Gunn suggested a new mode of origin of the Solar System, involving the fission of a single star, instead of the customary encounter of two stars.

Three papers dealt with the construction and operation of instruments. Moffitt discussed the application of the synchronous motor to the driving of telescopes. Olivier described a new and rapid method of calibrating the wedge of a stellar photometer. In a paper by Ross, it was shown that the use of a correcting lens in connection with a reflecting telescope produces a remarkable improvement of definition over a wide field.

As has been the rule in recent years, the majority of the papers bore more or less directly on astrophysics. Those dealing directly with observations of stellar spectra were seven in number: a study of the spectrum of α Canum Venaticorum, by Kiess; of the CH and CN bands in δ Cephei, by Swings; two papers on class B stars with bright lines, by Struve and McLaughlin respectively; on the spectrum and absolute magnitude of β Cephei, by Struve and Ogrodnikoff; on the behavior of hydrogen emission lines in some semi-regular red variable stars, by McLaughlin; and on the peculiar spectrum of 73 Draconis, by W. W. Morgan.

Mitchell gave an account of the eclipse expedition to "Tin Can Island" and showed newly detected structures in the coronal rings. Russell presented a paper on the opacity of stellar atmospheres and its effect on line intensities. Miss Moore described an extensive table of multiplets which she is preparing, and which should prove invaluable to the astrophysicist.

Two papers had to do with space-reddening of starlight. In one by Elvey and Mehlin it was shown that large color excesses in Cepheus occur mainly in the cases of stars located in regions of partial obscuration. In a paper by Mrs. Vyssotsky a possible absolute magnitude effect was suggested in addition to space-reddening as an explanation of abnormal colors of some class B stars.

Three papers bore more or less directly on stellar statistics. Bok outlined a new method of studying the space-distribution of stars by means of star-counts. Indirect star-counts, by intensity measures of extrafocal photographs of globular clusters, were discussed in a paper by Hogg. The partition of the giant stars into four sequences, faint, normal, and bright giants, and supergiants, was shown in a paper by Strömberg.

An apparent exception to the period-luminosity relation of the Cepheids was cleared up in a paper by Mrs. Hogg. A portion of the Lesser Magellanic Cloud forms a background of the cluster N.G.C. 362, and the variables in the field are at two different distances. Elements of the light variations of small range in the two components of ϵ Lyrae were given in a paper by Fath.

Interesting sidelights on astronomy are found in the papers by Stetson and Cobb, and by Skellett. The former showed a great increase in the intensity of radio reception with the decline of solar activity. The latter suggested that meteors, by producing ionization in the

Kennelly-Heaviside layer, impede the transmission of short radio waves. This paper figured in the news of the day under the headline: "Meteors Choke Radio,"—unwittingly a suggestion of a possible beneficial effect of meteors.

At the conclusion of the papers on Wednesday morning, Colonel Millis presented a summary of a paper not on the regular program. The central idea was the effect of the finite velocity of light upon our picture of the universe. Looking into the sky, we see the stars and nebulae, not as they are now, but as they were when the light left them. Hence we do not see the universe as a whole either in its present form or in the form it had at some instant of time in the past; we have only a composite picture of recent and remote past, depending on the distances of the bodies we observe.

A resolution of appreciation of the hospitality shown the Society was presented by Stetson and unanimously adopted at the close of the Wednesday morning session, when the meeting of the Society officially came to an end.

The American Section of the International Astronomical Union met on Wednesday afternoon. H. N. Russell, chairman of the National Committee, presided. A new constitution of the Section was adopted and plans for the coming meeting of the Union at Cambridge in September, 1932, were discussed. Several proposals were referred to Commissions of the Union.

Although most of the members and guests departed on Wednesday, Thursday morning found a fair sprinkling of astronomers at breakfast in the hotel cafeteria, fortifying themselves for the journey home. Undoubtedly the forty-seventh meeting will be remembered by those who attended it as an eminent success, scientifically and socially.

Auxiliary Apparatus for Planetarium Demonstrations*

By PHILIP FOX

It is sometimes stated that the Zeiss Optical Planetarium can reproduce in its synthetic sky all celestial phenomena visible to the naked eye. Certainly it can illustrate an amazing variety of them but there are some very interesting phenomena which it does not show. In the description of the instrument published in the March number of this journal, mention was made of three pieces of auxiliary apparatus to supplement the planetarium instrument in certain of the demonstrations.

Eclipse Apparatus. While the Planetarium shows with accuracy the

*These instruments were designed by the writer and constructed by Curt Richter, Technician, in the instrument shop of the Adler Planetarium and Astronomical Museum.

configurations for eclipses by bringing the Sun and Moon into conjunction or opposition at the correct dates, with the Moon near its nodal passage, the actual circumstances and appearances of the phenomena are not portrayed.

The device for showing eclipses (Fig. 1) is not new in principle. In fact, the suggestion for it came from a mechanical lantern slide which had been presented to the Museum by Professor Henry Crew of Evanston. This was one of a set of painted slides illustrating celestial objects and phenomena which had belonged to his father and prior to that to Richmond College of Richmond, Ohio, an institution which ran its life history between 1830 and 1860. They are old enough at least to antedate the use of photography for lantern slides.

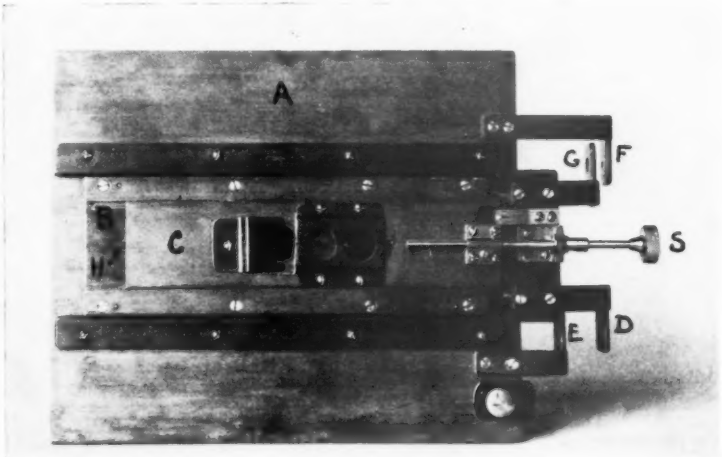


Fig. 1. Eclipse Apparatus.

In the device as developed here there are three superposed plates A, B, and C. The plate (A) serves only as a base plate or carrier. It is of proper width to fit into the projection lantern and has a single central aperture 11 mm in diameter. Plate (B) has two apertures, one the same size as that in the base plate (A), the other of such size (2.3 mm) that its projection on the far side of the dome has the same diameter as the Sun or Moon of the planetarium sky. This plate may be moved laterally a fixed amount equal to the distance between centers of its apertures by means of the grips (D, E) or (F, G). The range of motion is accurately controlled by a pin (H) in the plate (A) which fits in a slot in (B).

The third plate (C), mounted in ways on (B), has three apertures each equal in diameter to that of the base plate. Over them are mounted in succession miniature photographic slides for the solar corona, a dark

dot (2.3 mm in diameter) to represent the eclipsing Moon, and a larger semi-opaque dot for the Earth's shadow. The distance between the first two is exactly that between the apertures in (B) and therefore equal to the limited motion of (B). Plate (C) can be moved with respect to (B) by means of a long screw (S).

For a solar eclipse the procedure is as follows: let us say that we are going to reproduce the eclipse of the Sun of 31 August 1932. Employing the annual motion of the Planetarium, start three or four months in advance to show the location of the nodes and that the Moon will be north of the Sun at conjunctions. As the Sun and Moon approach the conjunction of August 31, it is apparent that the Moon will be near enough to the node to be within the ecliptic limits and therefore there must be an eclipse. We will suppose ourselves to be at some station where the eclipse will be visible at noon. The projection apparatus is so adjusted that the image of the Sun from it will be superposed exactly upon the planetarium image of the Sun at its noonday position of August 31. The lantern image of the Sun is produced by light through the smaller aperture of plate (B), which must be centered over the aperture in (A) and under the middle aperture of plate (C) with the dark dot representing the Moon close to and on such side of the aperture in (B) that the motion of the screw (S) will bring the Moon over the Sun from west to east. When the two solar images have been superposed the planetarium image is immediately extinguished. Only the image of the Sun thrown by the projection lantern is seen in the dome, for the planetarium Moon is too thin a crescent to be visible and on the day of the eclipse the Sun will have risen with neither stars nor planets shown in the sky. The dot on plate (C) representing the Moon is driven slowly across the image of the Sun until the Sun is entirely covered. This brings the solar corona central over the second aperture in (B). At second contact the two plates (B, C) are instantaneously moved by the grips (D, E) so that the corona comes central over the aperture in plate (A) and appears exactly in the position where the eclipsed Sun had been standing. At that instant also the stars and planets are made to appear in the sky. In a few moments, after the lecturer has spoken of the corona and various items pertinent to totality and eclipse observations, the grips (F, G) are pressed together and the eclipsed image of the Sun is substituted for the corona. Immediate resumption of the turning of the screw drives the Moon eastward slowly off the solar disk. With the first appearance of the limb of the Sun the stars and planets are extinguished. At such time as the Sun is completely uncovered, that is, after fourth contact, the planetarium image of the Sun is again introduced and the lantern image extinguished. Thereupon the diurnal motion is resumed and at sunset the stars and planets reappear. On the following day the Moon will be seen to the east of the Sun and south of the ecliptic.

If a double lantern is available the apparatus can be simplified in that

the instantaneous lateral displacement for the transition from the eclipsed Sun to the corona and *vice versa* can be eliminated. The image of the corona might be projected by the second lantern and be thrown on the screen at time of totality, dissolved in and out. This is a preferable arrangement. The images from the two lanterns must be exactly superposed.

For the lunar eclipse the procedure is considerably simpler. The lantern image of the Moon must be superposed on the planetarium image of the full Moon at some prearranged position, preferably the meridian, and of course with the Moon in position at some eclipse date. The three plates are lined up so that the small hole in the second plate, representing now the full Moon, shall be centered over the aperture in plate (A) and under the Earth's shadow aperture on the upper plate, the light passing just alongside the dark Earth's shadow on the miniature slide. When the lantern image has been substituted for the planetarium image the Earth's shadow is slowly driven from east to west across the image of the Moon by the screw (S) to produce the eclipse. The diameters of the Earth's shadow and the Moon have the proper ratio. There is no need of using the grips to displace the images for there is nothing like the corona appearing; the movement of the screw is continued uninterruptedly in the same direction until the eclipse is over. Under this procedure the routine of a lunar eclipse is not exactly followed for here the Earth's shadow is driven across the Moon which remains stationary among the stars, rather than the Moon overtaking and passing through the Earth's shadow. The dark disk for the Earth's shadow is not opaque for in nature except in very rare cases the Moon can be seen even when centrally immersed in the shadow of the Earth. By displacing the little photographic plate of the Earth's shadow from central position in its aperture, it is possible to produce partial eclipses and to correctly represent the actual degree of submergence of the Moon within the shadow for any given eclipse.

If it is desired to reproduce the circumstances with greater fidelity the apparatus should be capable of rotation so that the direction of approach of the Moon on the solar disk in a solar eclipse, or the Moon into the Earth's shadow in a lunar eclipse, shall be correctly represented.

This apparatus may be used for ordinary lecture-room demonstration employing a second lantern if desired to show the stars. The great advantage of the planetarium demonstration, in addition to portraying the whole sky, lies in depicting the course of the Moon in days prior to and following the eclipse.

Meteoric Shower Device. This also must be mounted in a stereopticon. The metal base plate of proper width to fit the lantern has a series of twelve narrow (0.3 mm) slits 4.5 cm long radiating from a central pin which serves as an axis for two thin rotating superposed disks. In the first a spiral slot (0.3 mm wide) is cut and in the second a narrow sector of adjustable width. The spiral is so cut that as the spiral-slotted

disk rotates at uniform speed the intersection of a radial slot and the spiral slot moves outward uniformly. Light however appears on the screen only when radial slot, spiral, and sector are superposed.

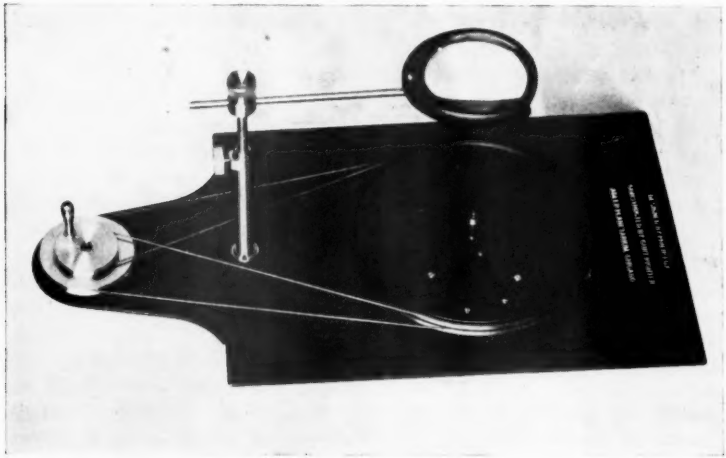


FIG. 2. METEORIC SHOWER DEVICE.

In Fig. 2 the general arrangement may be seen at a glance. The two disks are rotated in opposite directions with incommensurate periods. As the disks are of the same diameter (11 cm) and as they are driven by cords about their grooved peripheries, the incommensurate periods are provided by suitable choice of radii of the sheaves of the manually rotated driving wheel. Under this arrangement the meteors appear irregularly at various angles with paths of different lengths but with a well-defined radiant. The lens must of course have large aperture and short focal length that the maximum paths may be long. A conical screen enclosing the disks and the lens (not shown in Fig. 2) shuts off any light except that which passes through the lens; otherwise there might be faint general illumination of the dome with each meteor. In the planetarium sky the radiant can be directed to the appropriate place among the stars for the Leonids, Perseids, etc. A thin shower or a rich one can be had by slow or rapid rotation; of course this procedure for producing a rich shower entails swifter flights of the meteors themselves. Alternative arrangements whereby this change of pace can be avoided immediately suggest themselves.

If used for lecture-room demonstration, a double lantern would permit of projecting the appropriate star field and the shower simultaneously.

Aurora Borealis Device. The aurora presents multifarious manifestations in the sky with streamers, arches, pulsating patches as fairly

characteristic features and drapery or curtains as among the rarer effects, all moving and varicolored with white, green, and rose predominating. In planning the apparatus for projecting an aurora into the sky to illuminate the arctic night it was desired that the more prevalent aspects be shown.

The device consists primarily of two brass cylinders of diameter 5 cm, length 15 cm, set perpendicular to each other, (Fig. 3). The cylinder

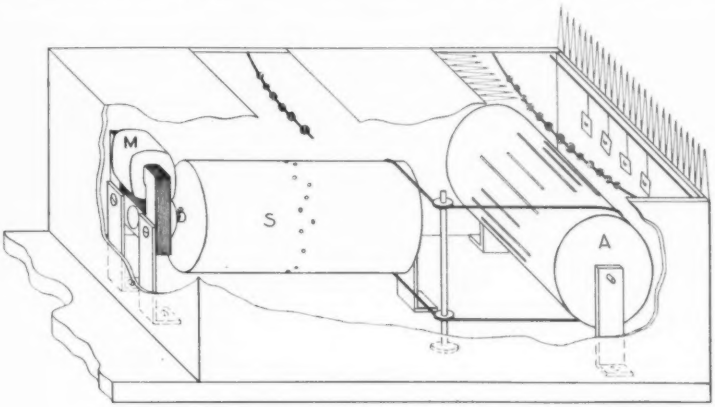


FIG. 3. AURORA BOREALIS DEVICE.

(S) has a series of perforations of diameters 1 mm to 2 mm drilled along an annulus at irregular intervals and staggered from the mean plane by 4 or 5 mm. The second cylinder (A) has narrow (1 mm to 2 mm) slits of lengths 5 to 8 cm cut at irregular intervals along elements of the surface. Both cylinders are rotated slowly by a small 6-watt telechron clock motor (M) which runs at one rotation per minute. Within each cylinder is a small 115-volt 25-watt tubular electric light. The whole is enclosed in a rectangular box, light-tight except for two apertures across the top, one over each cylinder.

If now this device is set up just within and below the base of the dome at the north side in such a way that the axes of the cylinders are horizontal, with that of (S) along the radius of the base of the dome, then the pencils of light through the holes in (S) will throw streamers on the dome radiating from an arc over the north cardinal point. These slowly wheel as the cylinder turns. The sheets of light from the slots in (A) intersect the dome as arches which, as the cylinder turns, appear low in the north and expand upwards, always roughly concentric with the north cardinal point. The narrow openings across the top of the box limit the region of visibility of the formations on the dome. The opening over (A) has deeply notched margins to give a gradual fade-out of the arches as they are vignetted. Glass plates painted in stripes

of translucent colors, rose and green, partially covering the openings in the box, give mild color effects. Strings of cut glass beads suspended in the openings, by their irregular refractions and reflections, give interesting ephemeral pulsations with streamers and arches at times broken up into curious evanescent coruscations. A series of small bright tin disks, mounted so that the ascending air currents from the heated cylinder (A) set them quivering like leaves of quaking aspen, also reflect moving patches of light irregularly on the auroral area. The intensity of the whole display is under rheostatic control.

This apparatus likewise is adaptable to use in a lecture room or might on larger scale be employed for display lighting effects.

ADLER PLANETARIUM AND ASTRONOMICAL MUSEUM,
CHICAGO, ILLINOIS, 7 MARCH 1932.

Unrealities of the Visible Skies*

By JOHN MILLIS

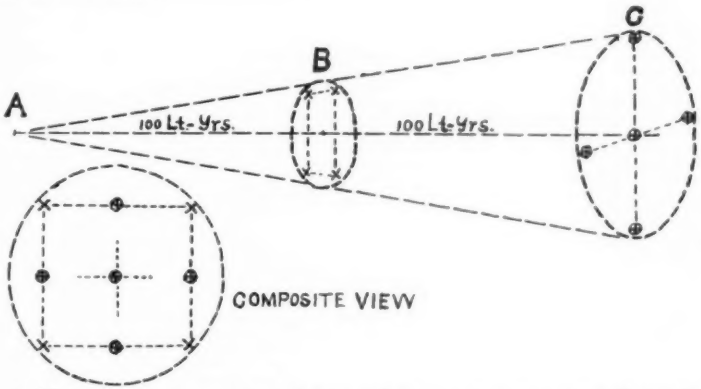
1. The prevailing widespread interest in astronomical knowledge and research is quite generally recognized. The general public has often been told of the more recent and notable advances in observing apparatus and plant, and of modern improvements in methods and processes to be found operative in a growing list of progressive observatories. Most people who read current periodicals are also aware of the carefully worked out projects already in progress and about to be undertaken, backed by ample financial resources and conducted by specially skilled and trained workers, for systematic and comprehensive surveys and mapping of the entire firmament, to include the most remote regions of space which it is now possible to penetrate. The accounts of the still more powerful telescopes than any heretofore built that are now under construction or projected and of the new wonders they are expected to reveal always make stories of marked popular as well as of scientific interest, and in quite recent years we have the several great dome-shaped structures in Europe, with one notable example in this country at Chicago,—the Planetariums—which are primarily intended to instruct and entertain the public at large in what are virtually astronomical museums, auditoriums, and moving picture houses on a grand scale.

2. The foregoing various factors lend a quite special interest to one feature of the results of the explorations of the skies already achieved, as well as of those confidently expected from the ambitious undertakings for further astronomical surveys and maps, that seems to have been quite generally overlooked. At least no clear and definite reference to the limitations imposed by the peculiarity of sky pictures and maps

*Presented at a meeting of the American Astronomical Society, Carnegie Institution Auditorium, Washington, D. C., December 30, 1931.

about to be described is found in literature accessible to the present writer, and indeed such pictures and maps seem almost invariably to be regarded and discussed without recognizing that in one important respect they are in a class apart from similar delineations of terrestrial areas and objects.

3. The reader will quite readily follow a very simple illustrative diagram to explain the feature referred to. We write down A to indicate the position of the observer who of course is on the earth. B, say a few inches to the right of A, is a star group one hundred light-years distant from A; remembering that the light-year unit for distances is the distance that light would travel at its normal rate of one hundred and eighty-six thousand statute miles per second in one of our calendar years. Let this group B comprise four stars appearing in the form of a square. C is a second group of stars one hundred light-years beyond B in the same line of sight from A. Group C is composed of five stars, in form looking from A like a right angled cross with equal arms and having apparent over-all dimensions corresponding to those of B. The observer at A will therefore see a composite group made up of B superimposed upon C, or in other words he will have a combined view or picture of the two groups apparently commingled, and for simplicity assume the relations to be such that the composite picture is a square with three equally spaced stars on each of the four equal sides and one star in the center.



4. Now in this composite picture, observer A sees group B in the particular arrangement and status that its stars actually had one hundred years ago. Likewise group C has the aspect for A corresponding to a time one hundred years before that, or two hundred years ago. Meanwhile some or all of the stars have had independent proper motions or motions in the line of sight, and they have also been affected by individual physical changes in other respects besides the alterations in relative position. These several influences have been operative in some

manner and degree during the respective past intervals of one and two centuries. While the observer's view or picture is a consistent or contemporaneous one as regards group B and also in respect to group C, each considered separately, the two must ever be one hundred years apart. But would it be practicable to apply adjustments and corrections so as to make the view correspond to some one period, say that of one hundred years ago? It is true that in many cases rates and directions of the proper motions of individual stars have been more or less correctly determined, and the same can be said of the motions in the line of sight and of variations in brightness and other changes, but these determinations are almost all based on modern observations and there is no known way of finding out anything very definite concerning variations in the laws of action of the several causes producing changes during the remote past or for the far distant future. There might be limited regions in the sky where the conditions and relations among the stars remain fixed and unchanging for periods measured by centuries, but from what we know of stellar motions in general such instances must be at least extremely rare. Then there is of course an exceedingly remote possibility that the changes in both star groups may be periodic and so related that appearances may repeat themselves, but this contingency may be dismissed as too improbable to be entertained for any general case. It is therefore deduced that a correct contemporaneous view or map for our composite representation of groups B and C corresponding to any one time is practically never realized and is virtually impossible of achievement.

5. Let it next be supposed that an attempt is made to apply the principles of this very simple and elementary illustration to the almost unimaginable complexities of the entire real heavens and the vast and endlessly varying distances and dimensions encountered by the astronomer in his studies of the great maze of bodies scattered throughout illimitable space. The scene in the field of the observer's telescope or on his photographic plate may be illustrated, though quite inadequately, by comparing it to one on a sort of phantom theatre stage that is seemingly set with painted scenery and stage properties and crowded with groups of actors. All of the objects and personages on the stage are largely or completely out of accord with each other as regards the period or time to which they respectively belong. There is an almost complete absence of contemporaneousness. Of the characters that a spectator sees and hears many and possibly all have long since permanently retired, while others have come on in their places of whom the audience is as yet totally unaware. No real scenes just like those within the cognition of the spectators watching the illustrative theater stage ever existed or ever will exist. What the audience sees are more or less distorted illusions, unreal visions, phantasms. One may here think of some of the products of modern graphic art or the somewhat similarly misshapen results of the early experiments in television, or of the comical reflec-

tions in mirrors made of curved or crooked glass.

6. It is obvious that the individual objects or things now appearing in the astronomical observer's general picture must have been in the field and where he sees them at some time in the past, but when? Two, five, or ten years ago? At the beginning of the World War—at the time of the Revolution—of the discovery of America? Before the Christian era—before the coming of the human race—or even before that? And where are these things now and what would the pattern look like if it could be seen as it is or as it ever was? And furthermore how about the objects that may have come into the field at periods in the past probably corresponding to the remote and variable epochs above suggested but which the observer does not yet see and whose existence he has not even reason to suspect? So far as can now be anticipated what the actual conditions in the field or region pictured were at any one time in the past, what they are now, or what they will be at any period in the future, it will be absolutely impossible ever to ascertain definitely or to portray with complete confidence. In the simple illustration it was assumed that the distances of the two star groups were known, but for any general case a major difficulty is found in the extreme meagerness and uncertainty of our knowledge of the real distances of the great majority of the more remote objects;—individual stars, groups, clusters, and nebulae.

7. It will be understood that the cause of this effect is simply in that light requires an interval of time for transmission from one point to another, which is directly proportional to the distance between the two. While this is so very minute for short distances as practically to escape detection, the time interval becomes appreciable with the vast distances separating the heavenly bodies and it may become very important. The moon is one and one-third light-seconds from the earth, the sun a little over eight light-minutes away, while the extreme distance to the remotest known planet of the solar system is roughly five light-hours. The comets go to somewhat greater distances in their elongated elliptical orbits, but otherwise there is no occasion to use such distance units as light-days or light-weeks or light-months. Our little group constituting the solar system is extremely lonesome and neighborless and it is a long jump to the nearest star—about four and one-third light-years distant. Then a few dozen of the nearest stars lead into light-centuries. The entire diameter of the great galactic assemblage in which we are located has been estimated at about two hundred thousand to three hundred thousand light-years; a magnitude for which the light-millenium would be a proper unit. Beyond this enormous aggregation are the observable island universes or nebulae whose distances are estimated in millions of light-years; and still no indication of a limit to the astronomers' explorations. While this effect is negligible in connection with most observations on bodies of the solar system and while it need not be taken

into account in many studies of individual stars and closely related pairs and groups that are much more remote, nevertheless it exists in some degree for all of these. Problems like that of the distribution of the galactic stars and of the form and structure of the whole galactic family, and investigations of star streaming or star drift, will be quite fundamentally influenced by a recognition of this effect. The farther we advance into the limitless background of the characters that have long been familiar in the foot-lights area of the celestial stage and the more the studies are extended to the significance of mass forms and groupings and of the seemingly obscured or vacant areas, the less real and dependable becomes the picture for this reason and the more must the uncertainties and confusion herein outlined be reckoned with.

8. The astronomical map should be thought of as having vast *depth*, even an unfathomable depth, as well as the other two dimensions of length and breadth that are characteristic of terrestrial charts, though these two dimensions and all distances parallel to the face of the star chart are generally measurable only in angular units since actual linear distances are dependent on the depth or distance away involved and therefore these are extremely variable for each map and cannot be indicated by any one linear scale. Moreover not only does the astronomical map depict objects of unrivalled remoteness in distance away but it affords an actual view into unexampled antiquity of time. It is interesting, even if not especially profitable, to sense the fact that in order to review, in the literal meaning of the word, any scene of world history however long past it would only be necessary to go far enough from the earth and then look back with sufficiently enhanced powers of vision for the oncoming light waves projected from the event to be witnessed; and similarly it is an alluring speculation to imagine observers on some of the distant bodies that we can easily see and to calculate what notable occurrences in the long history of the world they can now be watching; not merely in imaginative retrospect but in actuality—if they can see distinctly enough. For example such an observer on one of the planets of Rigel, the brightest star in Orion,—assuming that Rigel has a planetary system—might now be following Columbus on his first voyage of discovery and exploration to America; an event of over four hundred years ago but for the Rigel spectator one still in progress and over four hundred light-years away. Maps and pictures are being made of star clusters and spiral nebulae millions of light-years distant in space, but therefore showing the forms and positions they had millions of time-years ago,—perhaps, and perhaps we get only misshapen images of these objects and of their distribution and environment pertaining to unknown periods in the remote past. It would be a sufficiently formidable undertaking to try to figure out or even to imagine the changes that may have taken place in no more than a thousand years, and then to correct a map that much out of date, especially since the map is probably not completely reliable for that or any other particular period in the

past to begin with.

9. The reading public has been occasionally entertained of late with somewhat startling estimates of the size of the entire universe, and with announcements that modern observations on the remote nebulae indicate that these "are" all receding from us at truly frightful velocities, or that the universe "is exploding." Of course it is possible that these objects may be performing *now* just as they were doing countless ages ago but it is a rather long range process to deduce conclusions as to present conditions solely from observations of displacements of spectral lines, when these displacements, according to the estimates of distance made by the adventurous explorers in the profound depths of remoteness, must be dependent entirely on conditions which are now from one million to one hundred millions of years past. At best the observations referred to would warrant no more than a deduction that these bodies apparently *were* receding very rapidly from us some millions of years ago, but what they have done since or what they are doing now there is absolutely no direct evidence available to an observer on the earth to indicate; and it is not even altogether certain that the interpretation may not turn out to be quite wrong in principle anyway. As suggested above, a further caution is that it will be well to think of this effect even in connection with the observed shape and structure of objects like the remote clusters and nebulae which in themselves embody vast dimensions measurable in hundreds and even thousands of light-years. The sky map is perforce only a picture of appearances from the earth of the present. It may depart markedly in many respects and degrees from actual conditions of this or of any other period, and there is no known way to adjust it completely to realities, past or present.

10. It is not a mere fancy or figure of speech to say that outside of the limits of the relatively minute and extremely isolated spatial region that contains the entire solar system, the *present tense*, which is found so frequently used in astronomical thought and language and in astronomical literature, is largely inapplicable, or that it should generally be used with a special or qualified meaning.

11. The possibly far reaching consequences of this conception and its restrictions on man's efforts to comprehend the entire universe are somewhat arresting. It is not unthinkable that it may lead to a realization that we are enshrouded in an indefinitely far distant envelope of uncertainty, confusion, and impenetrable mystery, in which we may continue to search and flounder and grope but which we may never hope to resolve, even with the most powerful apparatus we will be able to build and the most searching processes we may be able to devise. We may be enabled to comprehend that what has heretofore been referred to as some limit to the created and explorable universe is not in the universe itself at all, but rather in the human sense organs and man's mental capacity and powers of comprehension, handicapped by inexora-

ble limitations imposed by nature's physical laws.

12. Let not the foregoing be construed as disparaging in the remotest degree or as intended to discourage or discredit the organized efforts now in progress by astronomers of first rank in various parts of the civilized world to survey and picture and study the entire heavens to the farthest reaches of space that can possibly be attained. Rather it should enhance the value and interest of astronomical studies to point out the effect above outlined and to indicate wherein the views of the skies from the earth and our sky maps and pictures are—and in so far as now foreseen ever must be—at least suspect and open to question, and *inherently prone to unreality*.

3250 Euclid Avenue, Cleveland, Ohio.

The Moon Considered as an Extinguished Sun

By JOHN LOWELL BUTLER

The surface features of our Moon have been a real puzzle from ancient times on down through the centuries to our own day. Even today there are many strange formations on the Moon that have not been satisfactorily explained heretofore by those who have tried to find the forces that produced them originally.

The unaided eyes of those who gaze upon the Moon see only blurs of dark and mottled areas on the Moon's sunlit silvery surface. The imagination of each observer has had to supply the lacking details; and as a result many interesting stories have originated throughout the world in which have been portrayed socially and religiously such charming myths as "the man in the Moon," or the "lady in the Moon," or a kiss, a rabbit, a great city, cassia trees, a hare and a rice mortar, a beautiful country. Mary Proctor, in her book "The Romance of the Moon" (1928) has given us many interesting details of these myths of the imagination and superficial observations.

After the invention of the telescope in 1600 by Lippershey, and its application to astronomy by Galileo whose telescope magnified the Moon's diameter 33 times, the mystifying dark and light areas of the Moon's surface were supplied with many details, which the observers thought were bodies of water and mountainous countries. As a result many fantastic names of an earthly character were given the larger surface features of the Moon, such as: Mare Nectaris (Sea of Nectar), Mare Foecunditatis (Sea of Fertility), Mare Tranquilitatis (Sea of Tranquility), Mare Crisium (Sea of Crises), Mare Serenitatis (Sea of Serenity), Lacus Somniorum (Lake of Dreams), Mare Frigoris (Sea of Cold), Sinus Roris (Bay of Dew), Sinus Iridum (Bay of Rain-

PLATE VI

PART OF THE NETWORK NEBULA IN CYGNUS.
(How nearly real is quite unknown.)

bows), Mare Imbrium (Sea of Showers), Oceanus Procellarum (Ocean of Storms), Mare Nubium (Sea of Clouds), and Mare Humorum (Sea of Humor). Some of the larger mountains were named Alps, Apennines, and Altai.

Continued study of the Moon's surface features with more powerful telescopes that revealed a wealth of smaller details brought the necessity of naming many of its mountainous features so they could be quickly designated from each other. In naming these features the custom was finally followed of using the names of philosophers and scientists. Large maps of the Moon contain hundreds of these names, such as: Tycho, Copernicus, Kepler, Gassendi, Archimedes, Newton, etc.

When our selenographers had accomplished the task of heavily loading our maps of the Moon with these terrestrial names it was natural that the majority of scientific theories concerning the causes that produced those lunar features should be essentially terrestrial.

Some scientists tried to explain the formation of the Moon's numerous ring mountains, or "craters," on the basis that violent volcanoes produced them by depositing a ring of fallen material many miles out from the central eruption. But on this basis it was impossible to explain why the overlapped portions of rings were completely obliterated. And the enormous size of many of these mountainous rings was against this explanation, for some of them were 150 miles in diameter, such as: Bailly (149), Grimaldi (147), Maurolycus (150), Newton (143), Otto Struve (150), Schickard (154), and Stöfler (150).

Other scientists tried to account for the Moon's ring formations on the basis that large meteors had fallen into the Moon and produced them. But strongly against this explanation is the fact that practically all the ring formations are round. To produce round formations with meteors it would be necessary for the meteors to fall vertically upon the surface of the Moon. The large number and the distribution of the round formations over the surface of the Moon is such that we know that these round formations could not have been made by meteors falling into the Moon. And accounting for the mysterious radiating white streaks from some of these round formations is impossible on the basis that they are rock powder that was splashed out over the surface of the Moon by the impact of meteors. Many of the ring formations do not have any of these ray systems about them; and, on the other hand, some of these ray systems are too large to be the result of splashed debris from fallen meteors.

Some scientists have tried to account for the mysterious ray systems on the basis that the surface of the Moon became cracked into radiating lines as it cooled and shrank, and that whiter material from beneath the surface flowed up and out from these radiating cracks. But this explanation fails to account for the presence of the white substance of these ray systems on the lofty heights of mountain ranges. If a mountain range were split wide open, liquids would not flow up to the top of

the crack everywhere, but would flow out and flood the surface of the Moon at the foot of the mountain ranges. Furthermore, there are no characteristic cracks, or "clefts," associated with these ray systems.

One scientist thought that the whiteness of the Moon's surface and the brilliant ray systems could be explained on the basis that the Moon is covered with a very thick layer of ice everywhere. But strongly against this explanation is the fact that the temperature of the surface of the Moon rises to the boiling point of water when the sunlight is shining on it vertically. If there were any ice on the Moon this temperature would melt it and change the surface features of the ice and also produce shifting clouds, all of which is against the facts of observation. The surface features of the Moon remain without change through the centuries; and shifting clouds on the Moon have never been seen.

Thus it seems that the surface features of our lone satellite are a puzzle which no man can solve. No one has succeeded heretofore in finding the causes that produced its strange surface features. These features seem to be an undeciphered rotund hieroglyphic language that holds the secret history of the Moon's true nature and its ancient life.

But when we consider our Moon as an extinguished sun we are surprised to observe how easy it is to read all its rotund hieroglyphics. On this basis we can show what caused *all* its surface features! The story is simple, direct, and emphatic. Briefly stated, *the surface features of our Moon were formed by the solar activities of our Moon when it was an active midget sun.* On this basis *our Moon is the inner core of a small extinguished sun.*

The most puzzling features of the Moon's surface are, in reality, the very best of evidence that our Moon was once an active midget sun. Perhaps the most baffling features of the Moon's surface, those which have been the hardest to account for, are its "ray systems."

With the aid of only a low powered telescope when the Moon is full we can see radiating from several of the Moon's craters, or ring formations, many very white lines on the surface of the Moon. These very white lines are in reality five to ten miles wide and hundreds of miles long; some are over a thousand miles long; and one is over 2,000 miles long! These ray systems often resemble the spokes of great wheels. Near the centers of these ray systems of radiating white streaks the surface of the Moon is usually whiter, as though it were covered with a large cloud of fallen white dust. This is often referred to as a "nimbus of light."

These strange radiating white lines and their accompanying nimbus of light *lie on top of everything in their vicinity.* They have no measurable height, but lie like great radiating streaks of "whitewash" or dust on top of mountain ranges, plains, and seas of lava. They show plainly that the rough surface of the Moon has not interfered in any way with their travel outward from their common centers. And some of them end in a relatively sharp outer point.

At the approximate center of each of these ray systems is always a round ring formation, which has been called a "crater" for want of a better term. Furthermore, these ray system craters are *always round and complete and distinct,* though sometimes they are a little irregular; and many of them are very large in diameter. Individual names have been given these ray system craters, such as: Copernicus (56 miles in diameter), Tycho (54), Byragius (40), Aristillus (34), Aristarchus

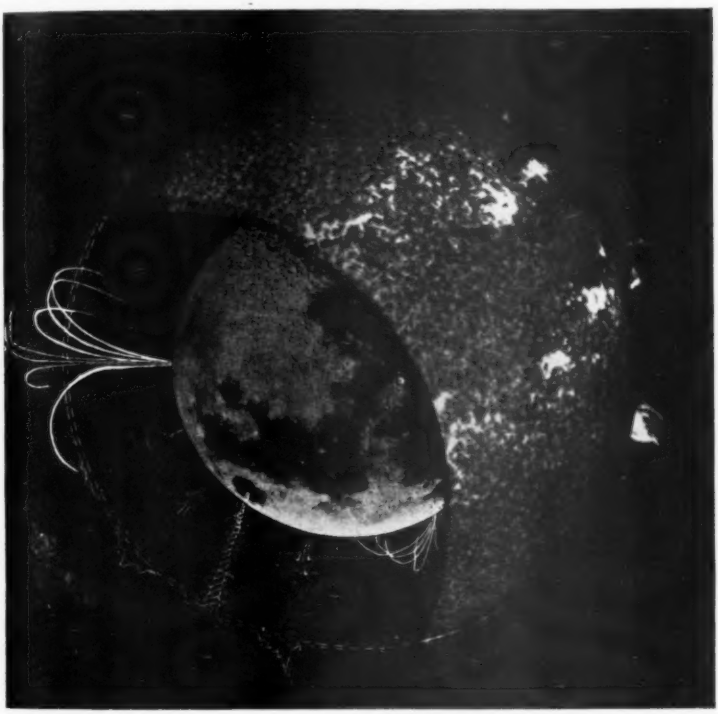


FIGURE 1.
LUNAR FEATURES AND SOLAR ACTIVITIES EXPLAINED.
Calcium spectroheliogram of the Sun's photosphere and prominences of May 22, 1916 (Mt. Wilson Observatory). Color-filter photograph of the Moon, age 9¾ days (Yerkes Observatory, 40-inch refractor), illustrating the nature and size of the Sun's inner core. Drawings by the author, John Lowell Butler.

(28), Timocharis (23), Kepler (22), Euler (19), Proclus (18), Messier (9), Euclides (7), Anaxagoras, Stevinus, Landsberg A, and many still smaller craters which are surrounded by a nimbus of light.

A careful study of these craters and their surrounding ray systems is very fascinating and profitable when we compare them with the metallic

eruptive prominences that frequently occur in our Sun. In at least six outstanding ways the Moon's ray systems resemble the Sun's metallic eruptive prominences. This is certainly sufficient evidence to prove scientifically that *the Moon's ray systems are the remains of some of its former metallic eruptive prominences.*

Let us consider briefly these six outstanding proofs that the Moon's ray systems are the remains of some of its former metallic eruptive prominences.

(1) First of all *the shape* of the Moon's ray systems corresponds to the shape of the Sun's metallic eruptive prominences. In the descriptive words of Charles A. Young, the metallic eruptive prominences of the Sun "sometimes consist of pointed rays, diverging in all directions, like hedgehog-spines," while at other times "they present most exactly the appearance of jets of liquid fire, rising and falling in graceful parabolas." (p. 164, "The Sun," 1929 edition by Charles G. Abbot.) The drawings of these solar eruptions which he presents, and which are reprinted on pages 157 and 163 of Charles G. Abbot's 1929 edition of "The Sun,"

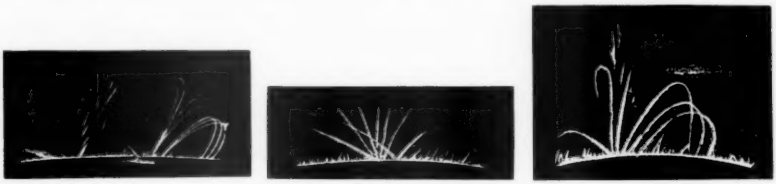


FIGURE 2.
DRAWINGS OF SOME SOLAR ERUPTIVE PROMINENCES.
See pages 157, 159, and 163 of *The Sun*, 1929 edition, by Dr. Charles Greeley Abbot, Director Smithsonian Astrophysical Observatory and Secretary Smithsonian Institution.

when compared with the Moon's ray systems, cannot fail to immediately impress everyone with the strong conviction that our Moon was once a midget sun with similar metallic eruptive prominences in violent action. Just as the shadow of a date palm tree resembles the tree itself, so these ray systems on the surface of the Moon resemble many of the metallic eruptive prominences that are active in our Sun today. In some instances both have many simultaneous radiating white rays that diverge from a common center, whose rays terminate in relatively sharp points. This is a remarkable similarity!

(2) Secondly, *the size* of the lunar ray systems compares perfectly with the size of the Sun's metallic eruptive prominences, when we consider the relative sizes of the two bodies and their respective surface gravities. On the basis that our Sun has a core like the Moon, and that its core has the same density as our Moon, it would be 520,205 miles in diameter. Thus the diameter of the Sun's core may be 240.8 times greater than the diameter of the Moon; while the surface gravity on

the Sun's core may be as much as 456.6 times greater than the surface gravity on the Moon. The solar metallic eruptions in the Moon shot their materials hundreds of miles above its surface and hundreds of miles from the centers of the disturbances; but the solar metallic eruptions in the Sun shoot their materials thousands and tens of thousands and even hundreds of thousands of miles above the surface of the Sun's core and thousands of miles outward from the centers of the disturbances! Therefore it is only natural to conclude that the enormous size of the lunar ray system that lies around the crater which is called "Tycho" is proof that it was produced by the violent action of one of the Moon's former solar metallic eruptive prominences. The sizes of the Moon's ray systems can be fully explained as due to solar forces of various strengths.

(3) Thirdly, *the topographical position* of the Moon's ray systems compares perfectly with the Sun's metallic eruptive prominences. The reason that the Moon's ray systems lie on top of everything else—mountains, crater rims, level plains, and seas of lava—is because they fell from such great heights! This is self-evident and needs no further comments.

(4) Fourthly, *the white color* of the Moon's ray systems corresponds to the predominating lime-light of the Sun's metallic eruptive prominences. The Sun's metallic eruptive prominences contain many elements, but nearly always the element calcium is prominent in them. Even the gaseous eruptive prominences, which consist largely of hydrogen, also contain some calcium. When the element calcium is heated to incandescence, as it is in the Sun's photosphere of 6000° absolute Centigrade (10,409° F), it produces a very brilliant white light that is called "lime-light." This brilliant lime-light is nearly always associated with the solar metallic eruptive prominences which resemble in their shape the Moon's ray systems. Now it is also a very interesting and instructive fact that the element calcium and nearly all its compounds when cold are also white! The surface temperature of the Moon, according to Drs. Nicholson and Pettit of the Mt. Wilson Observatory, ranges from 212° F (the boiling point of water) when the sunlight is shining straight down on its surface, to 254° F below zero when the black shadows of night envelop it. Within this range of temperature the element calcium and its compounds remain unmelted; and they also remain white in color. In conclusion, therefore, we may say that some of the white color of the Moon's ray systems is due to the presence of calcium and some of its compounds. In other words, the lunar ray systems contain lime, or "solar whitewash."

(5) Fifthly, *the nimbus of light,* which resembles a fallen cloud of white dust, that is associated with several of the central regions of the Moon's large ray systems, corresponds nicely with the "faculae" in the Sun, which are large brilliant areas in the photosphere that are very

rich in calcium vapor and are usually associated with the eruptive prominences. We may conclude, therefore, that these white regions on the surface of the Moon are the fallen remains of the Moon's former faculae. Their white color is partly due to the presence of the element calcium and its compounds. They are literally fallen clouds of lime dust.

(6) Sixthly, *the existence of a "crater" at the approximate center of each ray system* on the Moon proves that the solar eruptions of the Moon had their origin *beneath* the visible surface of the Moon. In the Sun the size, shape, and speed of its metallic eruptive prominences all indicate that they originate in a lava-flooded rigid sphere inside the Sun. We may conclude, therefore, that the Moon's ray systems are the fallen remains of its former solar metallic eruptive prominences which originated in the rigid portions of the Moon beneath its globe-encircling ocean of liquid lava. This latter statement of the Moon's globe-encircling ocean of liquid lava is supported by still more evidence which will be given later. As these metallic geysers shot up through an ocean of liquid lava they were transformed into a system of radiating jets. We see them in action in the Sun; on the surface of the Moon we see their fallen remains.

With these six outstanding groups of scientific evidence before us, all harmoniously proving that the Moon once abounded with violent solar metallic eruptive prominences and photospheric faculae of calcium vapor, we may be quite certain that our Moon is an extinguished midget sun.

It is now interesting to observe that since the large ring formations, or craters, that are centrally located in the Moon's ray systems were produced by violent solar eruptions, we may conclude that all the thousands of large and small round formations that are so characteristic of the Moon's surface were likewise produced by the same kinds of solar forces. In other words, these lunar craters are in reality perforations of the Moon's surface, which perforations were made by violent solar forces acting outward from within the Moon. This is why they were all originally round, and also why the overlapped portions of many of the perforations were completely obliterated. It also accounts for the heaving up of the surface of the Moon around each one of these perforations.

When we study the Moon's perforations, which are so numerous that its surface has the appearance of a sieve or vegetable grater, and endeavor to determine which perforations are the oldest and which are the youngest, it is evident at once that the most indistinct and incomplete, or overlapped, perforations are the oldest. They were rendered less distinct and were partially obliterated by later solar eruptions. The youngest perforations are those which are the most distinct and are complete circles, having never been overlapped by other eruptions. This places the perforations which lie at the centers of the lunar ray systems in the very youngest class. And since these very young ray system perfora-

tions vary in size from 56 miles in diameter down to many that are less than three miles in diameter, we must conclude that the size of the perforations is *not* an indication of their age. In other words, both large and small eruptions were simultaneous phenomena in the Moon. This conclusion is fully verified when we study the sizes of the Sun's eruptions. Both large and small eruptions occur simultaneously in the Sun; and, furthermore, the smaller ones are the more numerous, just as they were in the Moon.

In the Sun there is some variation in the appearance of the larger metallic eruptive prominences. Sometimes the large ones are numerous, and sometimes they are very scarce. Their appearance and failure to appear above the Sun's photosphere—which may be as much as 171,947 miles above the surface of the inner core—vary with the appearance and absence of sun-spots. When the large solar prominences are numerous, then the sun-spots are numerous. This is very tell-tale information. Evidently the violent eruptions in the Sun have something to do with the formation of sun-spots. The old saying that "all that goes up must come down," and the observation that in the well-formed, round sun-spots enormous quantities of solar vapors are descending toward the interior of the Sun, show that there is a circulation of substances in the Sun—from its inner core to its photosphere and back again. About every eleven years on the average this circulation is augmented, producing what are known as periods of maximum prominences and maximum sun-spots.

Since among the youngest perforations of the Moon's surface are many that are very large in diameter, we know that the Moon also had periods of maximum solar eruptions. As will be shown later, these were accompanied by periods of maximum moon-spots.

And now we are ready to consider another group of lunar evidence. The Moon has every appearance of having been flooded everywhere with an ocean of molten lava, on which floated a thick crust of lava-foam of a pumice-stone nature.

It is a general characteristic of all the larger ring formations that their inclosed regions are generally level and that they are very shallow in proportion to their diameters. Fauth has given us some interesting and enlightening statistics on this phase of the Moon's features. He says: "A dessert dish five inches in diameter (without the border) and less than a quarter of an inch in depth has twice as deep a cavity, proportionally, as the deepest of those depressions." (p. 67, "The Moon in Modern Astronomy," Philip Fauth, 1909). Fauth remarks that these depressions are so slight that if we could stand on the highest peaks on one side of these ring formations and look across to the opposite side the curvature of the Moon's surface inside these large circular formations would "cover the opposite wall" in many instances. These facts certainly show that the great holes made by the explosions of the Moon's solar eruptions were *always flooded with liquid lava afterwards.*

The extreme shallowness of all the large perforations, which are found in all quarters of the visible half of the Moon indicate that a great ocean of liquid lava underlay all the mountainous regions of the Moon's surface. In other words, the Moon's mountains were floating accumulations of lava-foam, or pumice-stone!

This ocean of molten lava that lay beneath the floating crust and above the inner rigid framework of the Moon must have been largely responsible for the transformation of the single-jet violent geysers into multiple streams that resembled complicated fountains of liquid fire radiating in all directions from their common centers simultaneously, as they do in the Sun today.

The occurrence of these solar eruptions beneath an ocean of lava may also help to account for the large sizes of the perforations in the floating crust of pumice-stone, while the stream of the geyser or the gas that continued to flow upward for some time after the initial outburst was often very much smaller in diameter. The central peaks, or cones, inside these large rings of floating lava-foam show us that after the violent initial eruptions occurred they were often followed by a geyser of gas or molten lava which drew some of the floating lava-foam that had slid back into the interior of the large ring toward the center and lifted it a little distance and then dropped it back to the surface of the ocean through which it was spouting. The comparatively small size of the central cones shows that the geysers themselves were small in diameter but also very speedy. While on the other hand, the large diameter of the surrounding ring of floating pumice-stone shows that the initial outburst of these solar prominences was very violent and sudden and possibly at varying depths beneath the ocean of liquid lava.

The latest studies of the Moon's mountainous regions have proved that they are composed of some substance that heats up and cools off *very quickly* in the presence and absence of sunlight. Dr. Paul Epstein found that such substances as granite, or lead, or sandstone, or lava, would not take in heat and give it up as quickly as the substances of the Moon's mountains. "Finally," Mr. Ransome Sutton informs us, "he tried a substance suggested by volcanists and geologists. That substance was pumice—the sandy, spongy framework of foam which forms on lava and hardens as the bubbles of gas in it escape—and in the presence of the same degree of heat as that which sunlight generates on the surface of the Moon, it heated, and cooled, at approximately the same rate as the Moon's surface heats and cools. If a great pumice-covered ball were substituted for the Moon, he concluded, it would also have chills and fever—be boiling hot at midday and more than twice as cold as the North Pole at night. And Chairman Wright, the geophysicist, experimenting in Washington, arrived at substantially the same conclusions." (The Los Angeles "Times" of January 26, 1930, Part II, pp. 1 and 2.)

Another peculiarity of pumice-stone is its ability to float, even on water. Therefore we are doubly certain that the Moon's mountainous

regions are composed of floating pumice-stone. And when we consider the fact that our Moon was once a very active midget sun, whose ocean of lava was being constantly churned and whipped into foam by its thousands of very violent submarine eruptions, we see why there was so great an accumulation of pumice-stone on its surface. It could hardly have been otherwise, in view of all the solar conditions prevailing within the Moon and in view of all the mighty solar forces at work while it was an active midget sun.

With these facts in mind it is now much easier to understand why the *mountainous* regions of the Moon's surface are shot full of so many holes, big and small, and why the mountainous regions are sometimes split wide open by clefts that have no regard for the surface topography. It is also possible to understand why we find many smaller round perforations centering right in the lofty rims of the big perforations, such as those in the rims of: Newton, Clavius, Wilhelm I, Heinsius, Capuanus, Cavendish, Hovel, Otto Struve, Hercules, Atlas, Cepheus, Hooke, Gauss, Posidonius, Cleomedes, Macrobius, Taruntius, Apollonius, Gutenberg, Albategnius, Thebit, Purbach, Zagut, Pitiscus, Maginus, etc. The violent eruptions from beneath the floating crust of pumice-stone heaved the crust upward in their immediate regions, thus forming the raised mountainous rims, and causing the *under* surface of the floating crust to slope upward toward these perforations. As a result, the surrounding rising gases in the boiling ocean of lava were collected and directed toward the rims of the larger perforations, thus causing smaller outbursts right where at first sight there appears to be the greatest resistance, but where in reality there was the least resistance.

The fact that the boiling gases were directed toward the rims of the larger perforations shows that the submerged portion of the Moon's floating crust was partly melted again by the heat of the ocean of molten lava on which it floated, and that its submerged portions stuck together with considerable tenacity. Otherwise the rising gases would have bubbled freely through it everywhere.

One very strange and singular feature of the Moon is *its surface seas of lava which have no rivers running down to them* from the mountainous regions! And, furthermore, these surface seas of lava seem to have submerged the pumice-stone crust so that *the crust underlies all these seas.* When eruptions occurred beneath these seas the crust was most always raised upward to the very surface again. These strange features are easily seen in good photographs.

For evidence that the floating crust was submerged by the lava of the surface seas, examine the Mare Serenitatis (Sea of Serenity) where the rims of the perforations called Posidonius and Lemonnier are partly submerged; also the Mare Humorum (Sea of Humor), where portions of Gassendi, Hippalus, and Doppelmayer are submerged; also the Mare Nubium (Sea of Clouds), where the submerged walls of Pitatus are noticeable; the Mare Nectaris (Sea of Nectar) has submerged much

of the northern rim of Fracastorius; and the Oceanus Procellarum (Ocean of Storms) has fully covered half of Letronne. Thus it is evident that these surface seas of lava were growing and encroaching upon the floating crust, and as they did so they submerged it. This, too, is proof that the submerged portions of the crust stuck together with considerable tenacity.

For evidence that the submerged crust underlay all the surface seas of lava, and was raised to the surface by the larger eruptions, examine almost any of the larger round perforations, or "craters," that stand surrounded with lava, such as: Kepler in the Oceanus Procellarum; Copernicus in the Mare Nubium; Timocharis in the Mare Imbrium, etc., etc. Dozens of examples might be cited.

FIGURE 3.

EAST CENTRAL VIEW OF THE MOON, AGE 15 DAYS.

Photograph taken October 2, 1925, with 100-inch Hooker reflector on Mt. Wilson, showing several "ray systems," or the remains of solar eruptive prominences, lying on seas of lava (Mare Nubium and Oceanus Procellarum) which originated in the solar craters called Copernicus, Kepler, Aristarchus, probably Vasco de Gama, and many smaller ones, such as, Timocharis, Euler, Euclides, Landsberg A, etc.

Here we certainly have a conundrum; a thick crust of pumice-stone that tends to float on the Moon's great ocean of lava, and yet it is submerged in many places by surface seas of lava that have no rivers running down to their shores from the mountainous regions of the floating

pumice-stone. The big question which looks us straight in the face is: *What formed these many surface seas of lava on top of the Moon's floating crust of pumice-stone?*

We cannot say that these surface seas of lava were formed as the result of lava flowing upward through holes in the Moon's crust, because the crust is composed of a light substance that tends to float. Because of the general tendency of the crust to float, any holes in it would cause the lava to flow *downward* and thus drain the surface seas. There is evidence that this very thing was happening, for, as Fauth tells us, "around the Mare Serenitatis, very clearly on the coast of the Mare Nectaris, and to the experienced eye just as clearly on the southwest and west borders of the great Mare Imbrium . . . we can perceive lines of cleavage in the plains (seas) running parallel to the coasts in wide circles. This points to a repeated sinking inwards." And so it does.

Where, then, was the lava coming from that formed the Moon's surface seas of lava on top of the pumice-stone crust? On the basis that our Moon was once an active midget sun these surface seas of lava can be fully accounted for. We have seen that our Moon was once very active with hundreds of solar eruptive prominences. Therefore our Moon must also have had many cyclonic whirlpools in its atmosphere, just as our Sun has when there are many violent eruptive prominences in action in it. We know that in the Sun the gases are descending and cooler in the well-formed sun-spot vortices. The inevitable result of this long continued process in the Sun's atmosphere must be the depositing of large amounts of condensed vapors, or lava, on the inner core of the Sun. Therefore, beginning at the other end of this logic, having before us on the Moon the end products we may be sure that they were produced by a similar solar process. In other words, the surface seas of lava on top of the Moon's crust of floating pumice-stone were formed by the descending condensed solar vapors in the Moon's former moon-spot vortices!

We have observed that in the Sun the sun-spot vortices become more numerous and large when the eruptive prominences increase in numbers. In the Moon's surface we notice that there is a goodly number of moderately large, distinct, and complete perforations accompanying the many seas of lava. These very plain facts show clearly that our Moon was in the midst of a period of maximum eruptive prominences and moon-spots when it became fossilized.

Furthermore, between the years 1672 and 1704 "no spots were recorded in the northern hemisphere" of the Sun. ("The Sun," 1929, Abbot, p. 193.) Usually there are equal numbers on both sides of the Sun's equator. On the Moon we observe that most of its surface seas of lava are on one side of its equator, the northern side. But a few were beginning to form south of its equator. Therefore, at the time that our Moon became fossilized, it was just emerging from a period of active moon-spots in its northern hemisphere. It was evidently approaching

the crest of a period of maximum number of moon-spot vortices and solar eruptive prominences, just as our Sun was in 1705. (See Table II, p. 186, "The Sun," 1929, C. G. Abbot.)

In our study of the Moon we have found that all its surface features can be fully accounted for in terms of solar forces and solar phenomena. With all these outstanding facts in mind it is easy to see that our lone satellite was once a very active midget sun! It was blazing hot outside and flooded with molten lava inside. It was belching forth great volumes of gas from its thousands of small and large eruptions, and washing its dense atmosphere of metallic vapors with thousands of spraying geysers, some of which reached upward into its visible atmosphere of lighter vapors and made wonderful displays of fireworks for the inhabitants of the Earth to behold. These were followed by weird moon-spots in which the excess of elevated vapors began to descend and whirl with the vehemence of solar cyclones, producing magnetic storms of tremendous power. *Our Moon was once a place of the most intense and abundant solar activities, as, wrapped in sheets of roaring flames, it swung around the Earth each month in the long ago.*

Judging from the many exact parallels of resemblance between our Moon and the Sun, our solar satellite must have been about as brilliant and hot as our Sun is today. But, of course, being smaller its *total* output of light and heat was not as much as the Sun's total output. If we allow the Moon's solar vapors to extend outward from its surface until its total density is reduced to the Sun's total density of 1.41, then the diameter of the Moon's brilliant photosphere was about 2,897 miles, while its rigid core inside was still only 2,160 miles in diameter. On this basis the Sun's photosphere has a surface area that is 88,968 times greater than the area of the Moon's former photosphere. Therefore our Moon emitted about 1/88,968 as much light and heat as our Sun does today.

The amount of radiation which we receive from the Sun at a distance of 92,900,000 miles is 1.94 calories per square centimeter per minute. This is known as the "solar constant." If the Sun were moved closer to us we would receive more radiation, for "the intensity of flux of radiation varies inversely as the square of the distance from the source" (p. 582, "College Physics," 1919, Reed & Guthe). If the photosphere of the Sun were as close to us as the Moon, just 238,857 miles away, then, theoretically, the Earth would receive 352,114.4 calories each minute on each square centimeter of surface that was at right angles to the sunlight.

But because the Moon's total radiating surface was only 1/88,968 part of the Sun's radiating surface the Earth received in the neighborhood of only 3.95 calories per square centimeter per minute from the Moon. And in addition to these considerations we must take into account the *shallow depth* of the Moon's former photosphere. While the Sun's photosphere of roaring flames may be as much as 2500 miles deep,

the Moon's photosphere of brilliant flames could not have been nearly so deep. Therefore, on account of the shallow depth of the Moon's burning photosphere, the Moon's surface did not radiate as much light and heat from each square meter of area on its surface as does the Sun today. Therefore the Earth did not receive as much as 3.95 calories per sq. cm. per minute from the Moon. We are safe in saying that *the Earth received approximately as much light and heat from the Moon as it now receives from the Sun,* that is, about 1.94 calories each minute on every square centimeter of surface that was at right angles to the rays of light—including the atmosphere.

The manner in which the Moon distributed its light and heat upon the Earth is very interesting. Because the Moon's orbit of travel around the Earth is inclined 28° 35′ 48″ to the plane of the Earth's equator it distributed its heat and light directly upon the center third of the Earth's latitude and well into both polar latitudes *every lunar month.* As an illustration you will notice that at present in the winter time the Moon, when full, rises in the northeast, swings high over our heads and sets in the northwest; while the Sun rises in the southeast, swings low in the southern sky at noon, and soon sinks out of sight in the southwest. Thus, if our Moon were now giving us heat and light as it did anciently, our winters could not be freezing cold! On the other hand, when the Moon is in the position of *new* moon, it rises and sets with the Sun in the southern sky during a brief period of each winter month. Or, to put it another way, it takes just about two weeks for our Moon to travel from a position above the Tropic of Cancer to a position above the Tropic of Capricorn, and then about another two weeks to travel back to the Tropic of Cancer. Thus there would be a period of only 27.3217 *days* from the time that our Moon was blazing high and hot in our northern skies until it was back there again. And because of its elliptical path around the Earth it lingered toward each pole, but moved quickly across our Equator. Therefore our winters *would not have time* to become freezing cold today if our fossilized solar satellite were giving us its own heat and light as it did anciently.

In concluding the present article it may be of added interest to refresh our minds with the conclusions of several noted scientists concerning this planet's ancient climate during the time that our Moon was an active midget sun. These men worked along other lines of scientific investigation and arrived at well-proved conclusions which harmonize perfectly with the discovery that our Moon was once an active midget sun.

Dr. F. H. Knowlton is a noted paleobotanist and was president of the Geological Society of America in 1918. He presented before this society a lengthy treatise that set forth the paleobotanical evidences from all the geological systems, from the Algonkian to the Tertiary inclusive, which reveal the temperature and moisture conditions of the climates in which all the ancient forms of plants and animals lived. His sum-

mary of the climates of the past was published in 1919 in the "Bulletin" of the Geological Society of America, volume 30, pages 499 to 565.

In his conclusion Dr. Knowlton said: "We have now passed somewhat hastily in review the salient facts relating to geologic climates as interpreted by and through fossil floras. This has been supplemented and confirmed in many cases by an appeal to the pronouncement of fossil faunas. It is perhaps not too much to say that it has now been demonstrated beyond reasonable question that climatic zoning such as we have had since the beginning of the Pleistocene did not obtain in the geologic ages prior to the Pleistocene. I think this statement of conditions is very generally accepted by geologists and paleobotanists—in fact, I am at a loss to know how the data available can be otherwise interpreted."—p. 538.

In introducing his study of the fossil plants, Dr. Knowlton made the following summary statements of the findings of the paleobotanists: "Relative uniformity, mildness, and comparative equability of climate, accompanied by high humidity, have prevailed over the greater part of the Earth, extending to, or into, polar circles, during the greater part of geologic time—since, at least, the Middle Paleozoic. This is the regular, the ordinary, the normal condition."—p. 501.

Howorth has given us a similar conclusion. He said: "We may examine the whole series of geological horizons, from the earliest Paleozoic beds down to the so-called Glacial beds, and find, so far as I know, no adequate evidence of discontinuous and alternating climates, no evidence whatever of the existence of periods of intense cold intervening between warm periods, but just the contrary. Not only so, but we shall find that the differentiation of the Earth's climate into tropical and arctic zones is comparatively modern, and that in past ages not only were the climates more uniform, but more evenly distributed over the whole world." ("The Glacial Nightmare and the Flood," pp. 426-479.)

Dr. Charles G. Abbot, Secretary of the Smithsonian Institution, said in 1929: "It is the general conclusion, based on fossil evidence, that during almost the whole duration of the world as the abode of life, its temperature exceeded the present. This geniality extended to the polar zones, so that in former ages the temperature was more uniformly distributed than now."—p. 324, "The Sun," 1929 edition, by C. G. Abbot.

In view of all these facts and abundantly substantiated conclusions it does seem reasonable to say that we have at last found one of the great reasons why our planet was warmer in ancient times, and why there was no interruption of that warmer climate until the Moon was extinguished, which event ushered in the Pleistocene age of glaciers and our modern extremes of zonal climates.

For a more complete study of the influence of our Moon on the Earth's climates read my scientific treatise on the "Astronomical Solution of the Ancient and Modern Climates" published in the January, 1932, issue of *Bibliotheca Sacra* (published quarterly for 75c a copy at

616 North Avenue, West, Pittsburgh, Pa.). And for an answer to the question, "Do all these scientific discoveries confirm the biblical record?" read my series of exegetical articles on the Bible's Story of the Astronomy of the Flood beginning in the February, 1932, issue of *The Watchman* magazine (published monthly for 25c a copy at 2119 Twenty-fourth Avenue, North, Nashville, Tenn.). A moderately sized book bearing the present title "The Astronomy of the Flood, Biblical and Scientific" is being put into final shape for publication at an early date, and will contain the following chapters: (1) The Bible's Story of the Astronomy of the Flood; (2) A Scientific Study of the Sun; (3) The Moon Compared with the Sun; (4) Reading the Fossil Record of the Ancient Warm Climate; (5) The Importance of the Ancient Water-vapor Shell; (6) Reading the Lunar Record of the Moon's Sudden Extinction; and (7) Reading the Geological Record of a Suddenly Chilled Earth. In the Appendix will be placed several closely related studies which expand certain phases of the main treatise.

934 Newton Avenue, San Fernando, California, June 3, 1931.

Astronomy in a Junior College

By FRANK B. LINDSAY

In a junior college students who study astronomy usually have diverse interests. At San Bernardino the student-body is about equally divided between those for whom the two years of junior college are the close of formal schooling and the group preparing for university entrance. The latter further subdivides into (a) students whose goals are engineering or research in particular sciences; (b) those who are looking toward careers in business, medicine, or law; and (c) majors in languages, literature, and the social studies. Only a small group is concerned with the technical aspects of astronomy. The larger number turn to it to obtain an adequate picture of the universe men live in.

Of all physical and natural sciences perhaps astronomy most completely satisfies the cultural requirements of men and women whatever their special field of activity. Historically, major advances in the science have always been forerunners of new eras of civilization. The concepts of astronomy with their applications to engineering and their philosophical implications have repeatedly challenged existing conditions—political, economic, social, and religious—and powerfully influenced the trend of developments. Thus the authority of church and the divine right of kings naturally accompanied the Ptolemaic conception of the universe. And the work of Kepler, Newton, and Laplace in celestial mechanics not only laid a foundation for the industrial revolution but accelerated the march toward democracy in government and liberalism in religion. Astronomy takes the discoveries of physicist and chemist out of their

academic (and restricted) setting, corrects and supplements them in the light of phenomena which transcend the resources of the laboratory, and presents them in their complete, cosmic significance. No wonder then that astronomy has entered more intimately into human thinking and become embedded more deeply in the world's literature than almost any other science. A junior college course in astronomy is an opportunity to acquaint young people with the contributions of astronomers to human knowledge in each of these several departments.

CLASS IN ASTRONOMY, SAN BERNARDINO, CALIFORNIA.

At San Bernardino Junior College the first year of the subject is organized about five objectives:

1. to acquaint students with the skies and early notions about the stars;
2. to present mathematical and physical ideas essential for interpreting the real nature of the universe;
3. to inform students as to the solar system and the earth as an astronomical body;
4. to introduce them to the stellar systems and the sun's membership therein; and
5. to enable them to read astronomical literature with understanding and discrimination—and to induce them to want to read it.

Of course, minor goals are included within the foregoing. As constituted, the work attracts many whose major subjects are English, History, Philosophy and other social studies.

More attention is paid to the constellations and their legends than

would ordinarily be given outside a junior college. One satisfaction astronomy should afford a one-year student is some familiarity with the star-groups and the distribution of celestial objects. During the spring semester of 1931 (by charging a nominal laboratory fee) through the interest and coöperation of the Williams-Pridham Index Globe Company (Glendale, California) every student was supplied a 12-inch black globe. They located upon these globes the positions and indicated the magnitudes of 357 bright stars. Binaries, variables, clusters, and nebulae were discussed as encountered in different parts of the celestial

Locating Celestial Objects on Globe.

sphere. At the end of the term each student took home as his property the completed globe upon which he or she had mapped and labelled the principal constellations and individual features of interest and importance.

Oftentimes students at San Bernardino elect astronomy as the lesser evil among the sciences. They love not stars the more but dissecting sharks or juggling test-tubes less! Their indifference (and, occasionally, even hostility) has usually been overcome by encouraging them to approach the subject through their chief interest. One instance is that of a young lady who frankly admitted at registration that she was taking astronomy because she "had to get in some science to graduate" and "expected to be bored to death." Yet her term paper which dealt with Dante's astronomical allusions in the Divine Comedy (of which she was passionately fond) was an outstanding piece of scholarly work. And

to evaluate Dante's knowledge of Ptolemaic astronomy she had to acquaint herself with historical details which kindled in her considerable enthusiasm for the whole subject. Similarly another student who investigated the Ptolemaic and Copernican elements evident in Milton's epic poems worked up an interest in astronomy for itself. Each student has been encouraged to pursue some particular aspect of the science far enough to achieve at least a slight feeling of mastery of that topic. In most cases the result has been a genuine appreciation of the problems and difficulties that beset astronomers and increased comprehension of the spirit of scientific investigation.

Throughout the course attention is directed to the light shed by particular celestial phenomena upon the main problems of stellar organization and development. Every effort is made to prevent lessons from becoming mere descriptive recitals or cataloging of unrelated events. At the beginning of study of the solar system suggestions are made that known data of the planets should provide possible keys for determining: (a) their habitability, and (b) origin. At once increased significance attaches to an otherwise routine task. As factors of climate and atmosphere, the tilt of a planet's equator, the period of rotation, the superficial gravity, and the albedo become absorbing and serious matters. Students concern themselves more readily with spectroscopy and atomic theory when reminded that starlight alone visits us from outer space to give us clues to the structure and destiny of the universe. In both their reading and telescopic observation emphasis is laid upon definiteness and accuracy of the information obtained and its implications in specific situations. In addition to the values for individual students, astronomy in a junior college serves to educate and increase a public appreciative of the labors and discoveries of astronomers and, incidentally, sympathetically disposed toward the financial requirements of research observatories.

COLTON, CALIFORNIA.

Planet Notes for May, 1932

By CLIFFORD E. SMITH

The *Sun* will be moving northeast from the central part of Aries to the central part of Taurus. Its distance from the earth will be about 93.6 million miles at the beginning of the month, and this distance will increase about 580 thousand miles during the month. The position of the sun on the first and last days of the month will be, respectively: R.A. $2^h\,32^m$, Decl. $+14°\,57'$; R.A. $4^h\,31^m$, Decl. $+21°\,51'$.

The phenomena of the *Moon* will occur as follows:

New Moon	May	5 at 12	M.	C.S.T.
First Quarter		13 " 8	A.M.	"
Full Moon		19 " 11	P.M.	"
Last Quarter		26 " 11	P.M.	"

Apogee	May	4 at	2 A.M.	C.S.T.
Perigee		18 "	12 P.M.	"

Mercury will be moving with an apparent easterly motion from the eastern part of Pisces to the eastern part of Aries. Its distance from the earth at the beginning of the month will be about 68 million miles; during the month this distance will increase about 40 million miles. The corresponding apparent diameters for these distances are, respectively, 9 and 5½ seconds of arc. At the beginning of the month Mercury will be an object of about the first magnitude rising about an hour and a half before the sun, and, at the end of the month it will be of about magnitude —0.5 rising about an hour before the sun. On May 8 Mercury will be at greatest elongation west (26° 25′). Mercury will be in conjunction with the moon on May 3 (Mercury 5¼° S), in conjunction with Uranus on May 6 (Mercury 2½° S), and in conjunction with Mars on May 18 (Mercury 2½° S).

Venus will be moving from eastern Taurus to the central part of Gemini. Its magnitude will be about —4 and it will set about three hours after the sun. Its distance from the earth at the beginning of the month will be about 58 million miles and its apparent diameter will be about 27 seconds of arc. At the end of the month its distance from the earth will be about 37 million miles and its apparent diameter will be about 42 seconds of arc. On May 22 it will be at its maximum brilliancy for this elongation. At that time it will be slightly brighter than magnitude —4. Conjunction with the moon will occur on May 9 (Venus 1¼° S).

Mars will be a morning object in Aries, rising about an hour and a half before the sun. Its distance from the earth will be about 210 million miles, and its apparent diameter will be about 4 seconds of arc. Conjunction with the moon will occur on May 4 (Mars 3½° S), and conjunction with Mercury on May 18 (Mars 2½° N).

Jupiter will be an evening object of brightness about —1.5 in eastern Cancer. Its apparent polar diameter will be about 34 seconds of arc, and its distance from the earth will be about 500 million miles. On May 4 Jupiter will be at quadrature east of the sun, and, thus, near this time it will be on the meridian about 6:00 P.M., Standard Time. Conjunction with the moon will occur on May 12 (Jupiter 2½° S).

Saturn will be a morning object in Capricornus of magnitude about +1. During the middle of the month its distance from the earth will be about 890 million miles, its apparent polar diameter will be about 15½ seconds of arc, and it will be on the meridian about 5:00 A.M., Standard Time. Also, at this time, its apparent motion will change from direct to retrograde. On May 24 Saturn will be in conjunction with the moon (Saturn 3¾° N).

Uranus will be near the sun in apparent position, conjunction with the sun having occurred on April 9.

Neptune will be in the constellation Leo about two-thirds of a degree north of the fourth magnitude star ρ Leonis. During this period its distance from the earth will be about 2800 million miles and its apparent diameter will be about 2⅓ seconds of arc. On May 26 it will be at quadrature east of sun, and at that time it will be on the meridian about 6:00 P.M., Standard Time. Conjunction with the moon will occur on May 14 (Neptune 1° S). On May 16 the apparent motion of Neptune will change from retrograde to direct motion.

OCCULTATIONS

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.
(Contributed by the office of the *American Ephemeris*.)

Date 1932	Star	Mag.	IMMERSION Greenwich C.T. h m	IMMERSION *a* m	IMMERSION *b* m	IMMERSION Angle E from N °	EMERSION Greenwich C.T. h m	EMERSION *a* m	EMERSION *b* m	EMERSION Angle E from N °
May 17	550 B.Vir	6.0	22 43.9	—0.4	+0.2	126	23 45.6	—0.8	+0.1	304
19	17 G.Lib	6.4	6 15.2	—1.3	—1.3	114	7 23.7	—1.0	—1.5	288
19	18 G.Lib	6.1	6 51.3	—1.2	—1.5	125	7 54.8	—0.8	—1.4	274
20	b Sco	4.7	7 0.9	—1.4	—0.7	80	8 6.5	—1.3	—1.7	305
22	W Sgr	4.3	7 14.2	—2.0	—0.8	129	8 11.3	—1.3	+0.3	224
25	27 Cap	6.1	9 29.0	—1.4	+0.9	45	10 48.2	—1.8	—0.1	252
	OCCULTATIONS VISIBLE IN LONGITUDE +91°, LATITUDE +40°.									
May 16	31 B.Vir	6.4	6 46.3	—0.4	—2.0	142	7 41.9	—0.3	—1.6	281
19	17 G.Lib	6.4	5 50.4	—1.5	—1.0	131	7 2.8	—1.7	—1.1	283
19	18 G.Lib	6.1	6 29.7	—1.4	—1.3	136	7 37.6	—1.5	—1.1	273
	OCCULTATIONS VISIBLE IN LONGITUDE +120°, LATITUDE +36°.									
May 16	31 B.Vir	6.4	6 44.7	+0.4	—3.4	189	7 18.1	—2.5	—0.4	248
20	b Sco	4.7	5 44.9	—0.8	—0.5	139	6 51.5	—1.9	+0.4	272
20	4 Sco	5.7	8 24.8	—1.4	—1.6	155	9 19.0	—2.3	+0.1	243
20	π Sco	3.0	9 53.8	—1.7	—0.3	72	10 58.9	—1.7	—1.8	312
25	27 Cap	6.1	8 10.5	—1.0	+2.4	41	9 10.5	—1.0	+0.8	286
28	342 B.Aqr	6.5	9 33.2	—0.2	+2.3	34	10 32.4	—0.7	+1.3	268

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

Following last month's plan we are continuing the tables giving the rates for some of our observers, dealing with unpublished material for 1931. Due to unavoidable causes, the lists of radiants are not yet ready. Considerable work has been done on several fireballs, the results of which will appear in due time. The writer has also prepared the final report of the Meteor Commission of the International Astronomical Union, and this has been sent in.

One of our Missouri members, J. Wesley Simpson of Webster Groves, Mo., has in the past few months, besides regular observing, undertaken to gather data on several fireballs seen in his state. It is an important work, and we only wish that others of our members would undertake it in their localities. At present New England is covered by Dr. W. J. Fisher at Harvard Observatory; that part of the

Middle West near Iowa by Prof. C. C. Wylie, University of Iowa; the Eastern Atlantic coast region from New York to North Carolina by our headquarters at Flower Observatory, Pennsylvania; Texas by O. E. Monnig at Ft. Worth; Oregon and Washington by J. Hugh Pruett of Eugene, Washington; and Missouri as stated. This, however, leaves vast areas of our country, to say nothing of Canada and Mexico, without regional centers. One of the most important things a member could do, who lives in a region not now cared for, would be to offer to undertake the publicity campaign both by press and personal letters, necessary to gather fireball data. This has to be begun without delay, once the fireball has been authentically reported, if it is to prove successful. It takes time and trouble, but it does not come often and a real service would be rendered the A.M.S.

Belated reports for 1931 continue to arrive. For ordinary meteors, R. C. Shinkfield of Adelaide, Australia, 5 meteors on one night, and for M. Geddes, of Otekura, New Zealand, 89 meteors making his year's total 1457. For telescopic meteors we have:

M. Dartayet, La Plata Observatory, Argentina	17
F. De Roy, Antwerp, Belgium	41*
F. J. Morshead, New Plymouth Observatory, New Zealand	4**
R. C. Shinkfield, Adelaide, Australia	2
	64

*Reports for 1928, 1929, 1930, and 1931.
**4 others previously reported for 1931.

We welcome as new members:

Smith College Observatory, Northampton, Massachusetts.
P. V. Stump, 304 Harvard St., Santa Paula, California.
Arthur L. Day, 99 Fair St., Laconia, New Hampshire.

CARLTON ABERNATHY, CLEARWATER, FLORIDA.

1931	Began	Ended	Total	Meteors	F.	Rate	Cor.Rate	Remarks
May 10	8:25	9:25	60	9	1.0	9.0	9.0	
15	8:30	9:00	30	4	1.0	8.0	8.0	
June 4	8:55	9:25	30	3	1.0	6.0	6.0	
5	10:00	10:45	45	6	1.0	8.0	8.0	One earlier.
6	8:30	9:35	65	11	0.8	10.1	12.6	
8	8:25	9:40	75	16	0.7	12.8	18.3	
9	9:45	10:45	60	16	1.0	16.0	16.0	
10	8:45	9:45	60	14	0.8	14.0	17.5	
11	9:30	10:15	45	9	0.7	12.0	17.1	
12	8:30	9:30	60	10	1.0	10.0	10.0	
14	8:55	9:40	45	8	1.0	10.7	10.7	
22	9:05	9:40	35	3	0.7	5.1	7.3	
23	9:06	9:51	45	6	0.7	8.0	11.4	
28	8:40	9:40	60	3	0.4	3.0	7.5	Full Moon
29	8:35	9:20	45	4	0.7	5.3	7.6	
July 1	8:45	9:45	60	6	1.0	6.0	6.0	
17	10:25	10:45	20	4	1.0	12.0	12.0	
18	9:35	10:05	30	5	0.7	10.0	14.3	
24	8:35	9:35	60	5	0.4	5.0	12.5	Full Moon
				20				Casuals

ALPHA NU FRATERNITY, BOULDER, COLORADO.

1931	Began	Ended	Total	Meteors	F.	Rate	Cor.Rate	Remarks
Dec. 10	10:06	12:01	115	13	1.0	6.8	6.8	

ALPHA NU FRATERNITY, DENVER, COLORADO.

1931		Began	Ended	Total	Meteors	F.	Rate	Cor.Rate	Remarks
Dec.	10	10:09	12:00	111	14	1.0	7.6	7.6	11 Geminids
	10	10:00	12:00	120	56	0.9			(a)
	11	10:00	12:25	145	176	1.0			(b)

(a) 29 Geminids; Count. 7 observers, total of individual observing times, 540 minutes.
(b) 121 Geminids; Count. 10 observers, total of individual observing times, 627 minutes.

R. H. AXTELL, LEWISTON, MAINE.

Sept.	5	11:20	11:40	20	11	0.9	33	[36.7]	Shipboard, 26° N., 74° W.

S. R. BAKER, YORK, PENNSYLVANIA.

July	28	10:07	11:17	70	4	1.0	3.4	3.4	One earlier

OTTIS C. BOBBITT, BROWNSVILLE, TEXAS.

Nov.	12	10:00	11:00	60	23	1.0	23.0	23.0	Count
	13	11:00	12:00	60	21	0.9	21.0	23.3	Count
	14	13:00	14:00	60	33	0.9	33.0	36.7	Count
	15	12:00	13:00	60	31	1.0	31.0	31.0	Count
	16	13:00	15:00	120	129		64.5		Count
	17	13:00	15:00	120	61	1.0	30.5	30.5	Count
	18	14:00	15:00	60	20	1.0	20.0	20.0	Count

H. A. BURNS, SPRING VALLEY, NEW YORK.

June	17	12:08	13:45	97	5	1.0	3.1	3.1	
	19	12:10	13:45	95	12	1.0	7.6	7.6	
July	16	12:23	14:23	120	16	1.0	8.0	8.0	

M. DARTAYET, LA PLATA, ARGENTINA. (G.C.T.)

Nov.	13	5:00	6:30	90	8	1.0	5.3	5.3	
	16	5:00	7:30	150	20	1.0	8.0	8.0	(a)
	17	5:00	7:30	150	29	0.7	11.6	16.6	(b)
	19	5:06	7:30	144	5	0.9	2.1	2.3	Dawn interfered.

(a) Dawn interfered; 5 Leonids. (b) Dawn interfered; 19 Leonids.

B. H. DAWSON, LA PLATA, ARGENTINA. (G.C.T.)

Nov.	13	5:00	7:20	140	14	1.0	6.0	6.0	(a)
	16	5:00	7:00	120	26	1.0	13.0	13.0	6 Leonids
	17	5:00	7:30	150	24	0.6	9.6	16.0	(b)
	19	5:06	7:30	144	18	0.9	7.5	8.3	(c)

(a) Dawn interfered; 3 Leonids. (b) Dawn interfered; 17 Leonids.
(c) Dawn interfered; 5 Leonids.

LINCOLN LA PAZ, COLUMBUS, OHIO.

May	23	11:25	16:25	300	35	1.0	7.0	7.0	
June	1	9:20	10:00	40	2	0.7	3.0	4.3	Moon
	5	10:15	12:35	140	10	0.8	4.3	5.4	Moon after 12:00
	8	9:45	11:10	85	5	0.8	3.5	4.4	
	12	10:30	11:03	33	1	1.0	1.8	1.8	
	18	9:30	10:00	30	1	0.9	2.0	2.2	

T. K. TOMKINS, NORTH HILLS, PENNSYLVANIA.

July	11	10:55	11:10	15	1	0.5	4.0	8.0	
	12	9:40	11:23	103	6	1.0	3.5	3.5	
	17	11:38	12:18	40	1	0.5	1.5	3.0	
	19	9:45	11:50	60	6	1.0	6.0	6.0	
	24	11:43	13:23	100	7	0.6	4.2	7.0	
	25	12:45	14:30	105	5	0.7	2.9	4.1	

J. W. MacQueen, Birmingham, Alabama.

1931	Began	Ended	Total	Meteors	F.	Rate	Cor.Rate	Remarks
May 9	10:00	11:15	75	3	0.9	2.4	2.7	
June 15	8:30	10:30	120	13	1.0	6.5	6.5	
July 8	10:00	11:30	90	3	0.9	2.0	2.2	
10	10:20	11:10	50	4	0.8	4.8	6.0	
11	9:45	11:05	80	8	0.8	6.0	7.5	
15	9:00	10:30	90	3	1.0	2.0	2.0	
Sept. 15	8:55	10:10	75	7	1.0	5.6	5.6	
17	9:05	10:05	60	9	0.9	9.0	10.0	
Oct. 11	8:45	9:50	65	10	1.0	9.2	9.2	
15	10:15	11:20	65	4	0.5	3.7	7.4	
Nov. 3	9:00	10:00	60	3	0.8	3.0	3.8	
5	9:00	10:00	60	1	1.0	1.0	1.0	

Blakeney Sanders, Ft. Worth, Texas.

April 21	14:12	15:33	81	10	0.7	7.4	10.6	
Nov. 17	15:40	17:05	85	20	1.0	14.1	14.1	5 others seen

Miss M. E. Trimmier, Chicago, Illinois.

July 23	10:00	15:10	310	20	1.0	3.9	3.9	

1932 March 17, Flower Observatory, Upper Darby, Pennsylvania.

Additional Counts of the 1931 Leonids

By C. C. WYLIE

Since the publication, in the February issue of this journal, of "The 1932 Return of the Leonid Meteors," some additional observations of the 1931 return have appeared in publications or been received by letter. A report from the Steward Observatory of Tucson, Arizona, appeared in the February issue of *Publications of the Astronomical Society of the Pacific*. The hour of maximum was estimated by Professor Beck as 4:30 A.M., 105th meridian time or $17^h\,30^m$, 90th meridian time and noon-to-noon reckoning. Observations made at La Plata by Messrs. Dawson and Dartayet were summarized in the March issue of Popular Astronomy. At La Plata, counts of the Leonids were made on the 12th, 15th, 16th, and 18th, the other mornings being cloudy. The individual counts are not given, but the statement is made that they were the highest on the morning of the 17th, civil time, or the 16th, noon-to-noon reckoning.

Dr. Joaquin Gallo, Director of the Observatorio Astronomico, Nacional, Tacubaya, D. F., Mexico, kindly sent us the counts made there, which are published with his permission. Observations were made from November 12 to November 17, inclusive. On November 16 there was a change of only one in the total number counted in the first half hour and the last half hour. The counts on the 17th tend to be a little higher for the same hours than on the 15th, and the note indicates more bright meteors were seen. This agrees with the Dubuque results previously reported, but as clouds and haze interfered at Tacubaya on both mornings the result should be more completely confirmed. On the whole, the Tacubaya counts verify the estimate of Professor Beck that the maximum occurred at $17^h\,30^m$, or our own estimate of 18^h given in the February issue of Popular Astronomy.

Leonid Counts Reported by Director Joaquin Gallo.

Four observers, the director and three others, were on duty each night. Some

very bright meteors were noticed at about 12^h on the night of November 16, but the observers had other duties and did not begin the counts until 15^h. The meteors were bright enough to attract general attention, and people came to the observatory to watch the display. One meteor left a trail visible for about 15 minutes. To agree with other reports, the times are 90th meridian and noon-to-noon reckoning.

1931	Began	Ended	Minutes	Meteors	Remarks
Nov. 12	15:30	16:00	30	26	
12	16:00	16:30	30	22	
12	16:30	17:00	30	9	
12	17:00	17:30	30	12	
12	17:30	18:00	30	4	
13	15:00	15:30	30	13	
13	15:30	16:00	30	23	
13	16:00	16:30	30	10	
13	16:30	17:00	30	15	
13	17:00	17:30	30	10	
13	17:30	18:00	30	4	
14	15:00	15:30	30	7	
14	15:30	16:00	30	19	
14	16:00	16:30	30	7	
14	16:30	17:00	30	15	
14	17:00	17:30	30	7	
14	17:30	18:00	30	6	
15	15:30	16:00	30	40	Note 1
15	16:00	16:30	30	22	
15	16:30	17:00	30	18	
15	17:00	17:30	30	22	
15	17:30	18:00	30	15	
16	15:00	15:30	30	148	Note 2
16	15:30	16:00	30	117	
16	16:00	16:30	30	136	
16	16:30	17:00	30	150	
16	17:00	17:30	30	144	
16	17:30	18:00	30	149	
17	16:00	16:30	30	35	Note 3
17	16:30	17:00	30	29	
17	17:00	17:30	30	22	

NOTES.

1. November 15—Cloudy until 16^h and hazy afterwards. The greater number of meteors were seen to the southwest and northwest.
2. November 16—The 844 meteors observed were distributed as follows: Northeast, 243, southeast, 191; southwest, 213; and northwest, 197. At $15^h\,10^m$ a very bright meteor fell from Hydra to the south leaving a trail visible for $5^m\pm$. The most brilliant meteor seen, fell at $16^h\,10^m$ from Pollux to the constellation Taurus, leaving a trail visible for $15^m\pm$.
3. November 17—Cloudy and hazy to 16^h, and becoming hazy again after $17^h\,30^m$. After 18^h some very bright meteors were noticed.

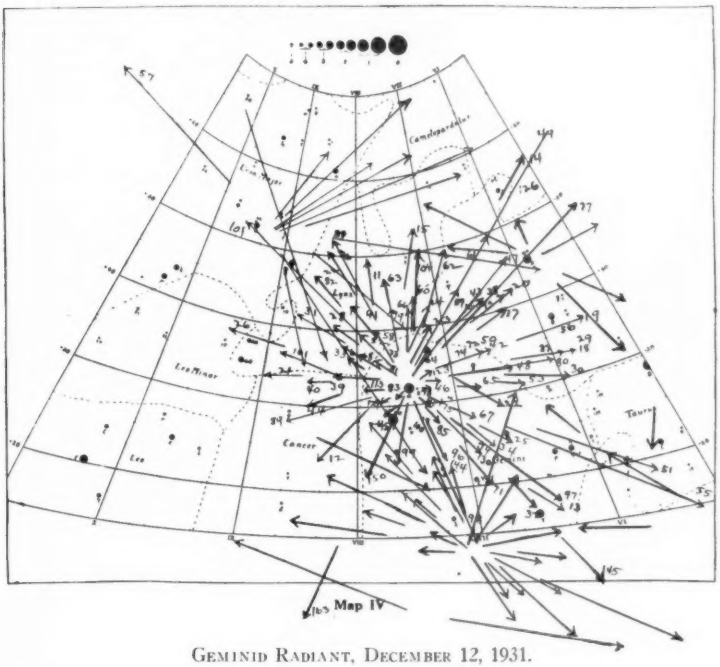
University of Iowa, March 19, 1932.

Meteor Radiants for 1931

By R. M. DOLE

GEMINIDS

The shower of Geminids is one of the most interesting and most active, and, in certain years, brilliant. Although December 11 at the maximum was cloudy,



GEMINID RADIANT, DECEMBER 12, 1931.

good results were obtained on the night of December 12. There were three other active radiants, the shower from near λ Gemini being very fine and producing very bright, slow fireballs. The meteors from Auriga, Ursa Major, and Orion were also slow and quite active. From Ursa Major they were very slow and long. The Geminids were short and not very bright and without trails. But number 57 in Ursa Major was equal to a quarter moon. A number of brilliant fireballs were noted by people on the streets. The shower was still active on December 15 and a shift was plainly mapped.

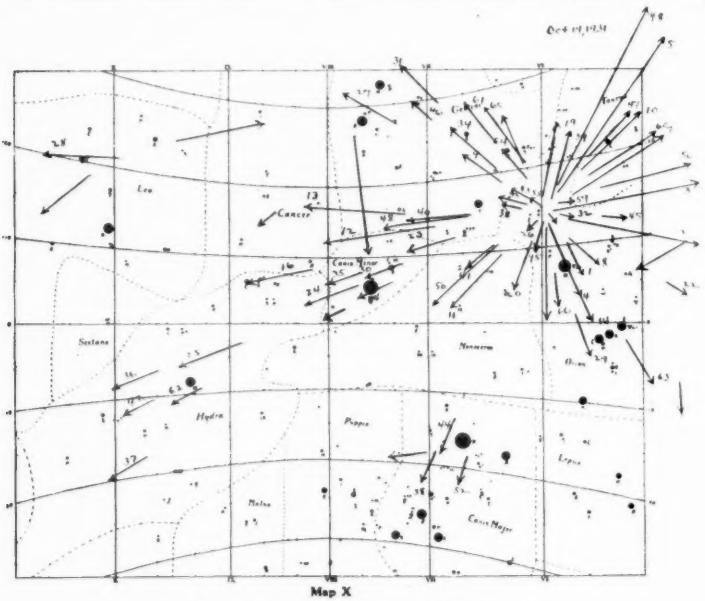
December 10		December 12		December 15	
10:30-11:00 P.M.	9	8:40- 8:50 P.M.	8	9:00- 9:30 P.M.	9
		9:10- 9:25	14	9:30-10:00	5
Total	9	9:35- 9:45	13	10:00-10:30	12
		9:45-10:00	11		
		10:10-10:15	15	Total	26
		10:20-10:35	13		
		10:45-11:00	16		
		11:10-11:15	22		
		11:25-11:40	13		
		11:45-12:00	15		
		12:10-12:25	14		
		Clouded over			
		Total	154		
		Others	50		

Mag.	6	5	4	3	2	1	0	—1	—2	—3	—4	—5	—6	—7	—8
No.	32	20	22	49	30	14	13	4	3				1		1

Total Geminids 189, others 50.

ORIONIDS.

After persistently poor weather for two years at the dates of the principal meteor showers, October, 1931, was favorable and a series was obtained from October 19-23, which shows the shift of the radiant point. The October meteors are interesting because of the number of showers, all active during the active time of the Orionids. Radiant points were noted in Leo, five different points in Orion,

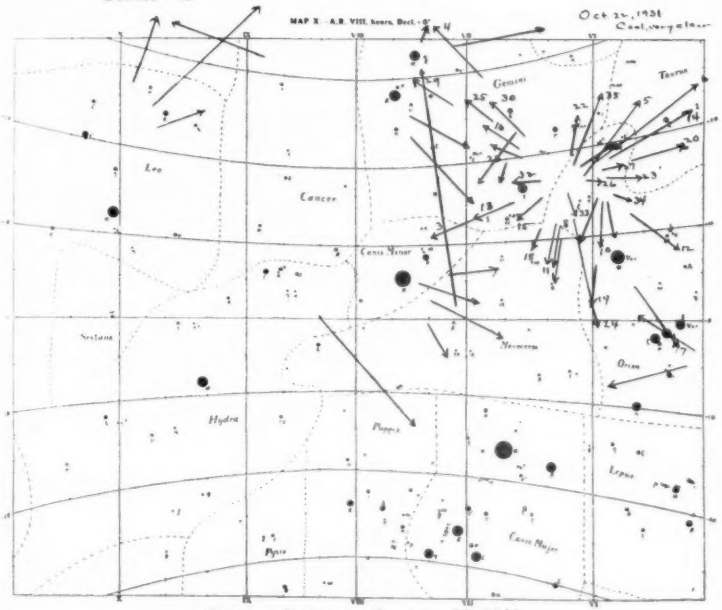


ORIONID RADIANT, OCTOBER 19, 1931.

three in Taurus, and three in Gemini. The showers from Canis Minor and Major were not active. The Orionids were rather faint as a rule and reached a maximum on October 21.

October 19		October 20		October 21	
2:45-3:00 A.M.	8	2:00-2:15 A.M.	9	1:45-2:00 A.M.	11
3:00-3:15	7	2:30-2:55	9*	2:15-2:30	11
3:15-3:30	5	3:25-3:30	2*	2:30-2:45	7
3:30-3:45	8	3:30-3:35	10	2:45-3:00	8
3:45-4:00	7	3:45-4:00	4	3:15-3:30	10
4:00-4:15	8		—	3:30-3:45	13
4:15-4:30	14	Total	34	3:45-4:00	10
4:30-4:45	9	Others	15		—
	—	*Partly cloudy		Total	70
Total	66			Others	25
Others	12				

October 22		October 23		Total Orionids	232
3:30-3:45 A.M.	10	3:45-4:00 A.M.	10	Others	76
3:45-4:00	3	4:10-4:30	4		
4:00-4:30	9	4:30-4:45	13		
4:30-4:45	13				
		Total	27		
Total	35	Others	5		
Others	19				



ORIONID RADIANT, OCTOBER 22, 1931.

	Mag.	6	5	4	3	2	1	0	−1	−2	−3
Oct. 19	No.	16	5	5	17	17	1	2	2		1
20		11	2	4	6	4	2	5			
21		20	21	6	7	8	2	5	1		
22		12	8	3	8	2		2			
23		6	10	1	5	2	1	1	1		
Totals		65	46	19	43	33	6	15	4		1 = 232

The weather was beautifully clear, except for sheets of clouds on October 20, when mapping and counting were discontinued. It was noticed again as in years past that on October 22 there was a minor radiant apparently from V Orionis, where the radiant point of the main shower had been on October 19. On October 22 the shower from α Canis Minoris was in evidence but not to compare with past years; the Leonids were active, but have nothing to do with the November shower. It is remarkable that there are showers emanating from the brightest stars in all the constellations near Orion, as well as well-defined showers near the Pleiades, which were not at all active this year.

Portland, Maine.

Comet Notes

By G. VAN BIESBROECK

The first quarter of the year has gone by without any new comets being reported; in fact seven months have now passed since the last discovery was made by P. Ryves. In the meantime two periodic comets have been seen again: 1931 *d* (NEUJMIN) which was identified on plates taken last September by S. B. Nicholson and periodic comet GRIGG-SKJELLERUP which was announced by the writer on March 6, and which will therefore be designated as COMET 1932 *a*. By means of the ephemeris given on p. 169 the search was started here early in March but curiously enough for more than a week the path of this faint comet lay across the densest part of the Orion Nebula so that there was no chance of revealing its presence. On March 6 the predicted position was in the black gap between the main part of the Orion Nebula and the smaller nebula NGC 1977 north of it. A pair of plates taken here on that night with the 24-inch reflector showed a very diffuse and faint nebulous patch, moving by the proper amount in the half-hour interval between the two exposures. The diameter appeared about one minute of arc but the total brightness was hardly as great as that of a 16^M star. There was the additional difficulty that even though the background is fairly dark in that region there is some tenuous nebulous material spread irregularly over it and further confirmation seemed desirable. But the next few days the object passed over the nebula NGC 1977 mentioned above and by the time it emerged from the outskirts the moon interfered so that the evidence depends on the results of the single night, that of March 6. An earlier exposure on February 25 had not shown any trace of the presence of the comet. These coming days conditions will be favorable again; we can expect the comet to brighten up some but it will probably remain a difficult object through this whole apparition. The first observation gave:

1932 March 6.06266 U.T. $5^h\,31^m\,49^s.33$ $-5°\,3'\,0''.0$ 16^M

which is quite close to the ephemeris position and confirms the date of perihelion (May 18.795) given by M. Davidson.

It may be recalled here that this comet was first discovered July 22, 1902, by J. Grigg at his private observatory in New Zealand. Only a few rough positions were obtained by him at that time. The object was independently rediscovered by J. F. Skjellerup at Rosebank (South Africa) on May 16, 1922, and its identity with the comet of 1902 was soon suspected. G. Merton made a thorough investigation of the orbit; he confirmed the identity and made a prediction for the 1927 return which proved to be very accurate. M. Davidson brought the elements up to 1932 with the inclusion of the perturbations by Jupiter:

$$\begin{aligned} T &= 1932\ \text{May}\ 18.795\ \text{U.T.} \\ \omega &= 355°\ 15'\ 24''.2 \\ \Omega &= 215\ \ 30\ \ 48.8 \quad 1932.0 \\ i &= \ \ 17\ \ 27\ \ 58.2 \\ e &= 0.69038 \\ q &= 0.90829 \\ \text{Period} &= 5.0829\ \text{years} \end{aligned}$$

Next to Encke's this is the shortest period known among comets.

Further observations have been made on two previously announced comets: COMET 1931 *b* (NAGATA) was photographed here on March 6 and 10 near the

position indicated by the Berkeley computers but it is now so faint that long exposures are required to show its faint coma.

COMET 1925 II (SCHWASSMAN-WACHMANN) maintained itself practically unchanged at 14^M up to the end of February but on March 8 it had suddenly lost about two magnitudes. This object therefore continues to exhibit the most peculiar fluctuations in brightness which cannot be accounted for by the small changes in the geometric conditions of visibility.

In Publication No. 7 of the Astronomical Institute of Warsaw (Poland) F. Kepinski gives a carefully computed ephemeris for PERIODIC COMET KOPFF which may be found in April:

1932	α h m s	δ ° ′
April 2	15 28 40	−29 34.6
6	29 49	42.2
10	30 30	46.8
14	30 42	48.2
18	30 26	46.2
22	29 43	40.3
26	28 32	30.5
30	26 57	−29 16.4
May 4	15 25 0	−28 57.9

Southern observers have the best chance of recovering it.

NEUJMIN'S SECOND PERIODIC COMET will be favorably situated in April according to A. C. D. Crommelin (*Handbook for 1932*, British Astronomical Association, p. 37) and the search can now be started:

1932	α h m s	δ ° ′
March 27	4 25 56	+28 33
April 2	4 41 41	28 26
8	4 57 53	28 19
14	5 14 59	28 4
20	5 32 42	27 43
26	5 50 57	27 15
May 2	6 9 41	+26 39

Williams Bay, Wisconsin, March 23, 1932.

Variable Stars

Monthly Report of the American Association of Variable Star Observers for February, 1932

We welcome new contributions from B. C. Darling of Lansing, Michigan, R. H. Wilson, now observing with Dr. Olivier at the Flower Observatory, and Sears Roach, coöperating with the Texas observers at Fort Worth, Texas.

We call attention to two misprints in the reports for 1931, as follows:

014958 X Cas J.D. 6505 Bn, *for* 11.0 *read* 11.9.
123459 RS UMa J.D. 6409 Bn, *for* 12.8 *read* [12.8.

The R Coronae Borealis type variable S Apodis again appears to be decreasing in light and closely following its slight rise from magnitude 11.6 last September. Southern observers should follow its variations with extreme care.

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

Dec. 0 = J.D. 2426676; Jan. 0 = J.D. 2426707; Feb. 0 = J.D. 2426738.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Scl	T Cas	S Cet	V And	U Tuc	U Psc
000339	001755	*001909*	004435	*005475*	011712
681 12.4 Bl	725 8.8 Pt	725 12.7 Pt	720 11.4 L	692 8.5 En	733 12.7 Mg
683 11.6 En	726 8.6 Th	734 12.9 L	730 11.0 L	699 8.3 Bl	RZ Per
688 11.9 Bl	730 8.4 L	T Scl	731 11.0 Jo	703 8.6 En	012350
692 11.0 En	731 8.4 Th	*002438a*	733 11.0 B	704 8.6 Sl	690 9.7 Ch
699 10.8 Bl	732 8.0 Mp	683 11.7 En	735 10.7 Jo	707 8.4 Bl	707 9.6 Mp
704 10.8 En	733 8.6 Mc	692 12.6 En	737 10.4 Wn	712 8.9 Sl	723 10.2 L
707 10.7 Bl	734 8.3 Th	706 12.8 En	744 10.1 B	721 9.1 Sl	732 10.4 L
S Scl	735 8.8 Ah	T Phe	X Scl	Z Cet	732 10.6 Mp
001032	735 8.6 Jo	*002546*	*004435*	*010102*	744 10.5 B
681 8.1 Bl	738 9.3 Wy	681 11.0 Bl	707 13.2 Bl	720 10.3 L	R Psc
683 8.3 En	741 8.1 B	683 10.6 En	RR And	725 9.7 Pt	012502
688 8.2 En	R And	688 10.5 Bl	004533	730 11.1 L	683 8.9 Ch
688 8.6 Bl	001838	692 10.4 En	689 8.6 Ch	U Scl	690 9.5 Ch
692 8.3 En	676 10.1 Ch	699 9.9 Bl	716 9.4 B	*010630*	708 10.8 Ah
699 8.9 Bl	691 9.6 Ch	704 10.4 En	733 10.1 Mg	681[13.2 Bl	725 11.8 Pt
704 8.9 En	707 8.1 Jo	707 10.1 Bl	736 10.5 B	707 12.8 Bl	RU And
707 9.1 Bl	708 8.4 Ah	716 10.3 Sl	RV Cas	U And	013238
X And	711 8.0 Jo	W Scl	004746a	010940	689 13.0 Ch
001046	714 7.9 Jo	*002833*	689 9.7 Ch	689 10.7 Ch	723 13.2 L
707[13.4 Ch	714 7.7 Ah	683 13.3 En	716 9.3 B	720 10.5 L	732 13.4 L
735[13.6 B	716 7.5 B	706 13.0 En	725 9.0 Pt	725 10.3 Hu	733 13.0 Mg
739 13.9 Bw	720 7.1 Ah	Y Cep	736 9.7 B	730 10.6 L	733 13.2 B
T Cet	720 7.0 Ko	003179	737 9.8 Sf	731 10.8 Hu	737 12.7 Ma
001620	720 7.6 Jo	677[11.8 Ch	— Cas	733 10.8 Mg	737 12.7 Wn
722 6.1 L	722 7.3 Ah	α Cas	004746b	UZ And	Y And
734 6.2 L	725 7.1 GD	003656	725 10.9 Pt	011041	013338
T And	725 7.0 Pt	725 2.5 Oy	W Cas	689 11.4 Ch	723 10.3 L
001726	725 6.9 Hu	731 2.3 Oy	004958	733 13.9 L	725 10.5 Hu
676 8.1 Ch	726 7.0 Ko	759 2.4 Dg	689 9.9 Ch	733 13.3 B	725 11.1 Pt
688 8.2 Ch	726 7.1 Ah	769 1.8 Dg	706 9.7 Jo	737 13.0 Ma	731 9.8 Hu
702 9.2 Ch	727 7.0 Ah	777 2.0 Dg	711 9.5 Jo	737 13.5 Wn	732 9.9 L
707 9.9 Jo	728 7.0 Ah	779 2.0 Dg	714 9.3 Jo	739 13.8 Bw	733 9.6 Mg
711 10.0 Jo	731 6.9 Ko	788 1.9 Dg	717 9.0 Jo	744 13.1 B	733 9.8 B
716 9.8 Th	731 6.8 GD	791 2.5 Dg	721 9.0 Jo	S Psc	737 9.6 Ma
717 9.9 Jo	731 7.0 Jo	U Cas	721 10.4 Ko	011208	737 9.6 Wn
720 10.0 Jo	733 7.0 Mg	004047a	725 10.3 Bo	733 14.5 L	X Cas
725 10.2 Pt	735 7.1 Ah	689 10.3 Ch	725 9.6 Pt	S Cas	014958
725 10.9 Hu	735 7.2 Jo	720 13.0 L	727 10.0 Bo	011272	707 10.5 Mp
731 10.8 Hu	735 7.1 Gy	725 12.8 Pt	732 9.9 Bo	680 9.4 Ch	707 10.7 Jo
731 10.9 Hi	736 7.0 Ah	725 12.4 Hu	733 9.6 B	707 8.4 Jo	711 10.9 Jo
731 10.5 Jo	736 8.0 B	730 13.0 L	734 10.0 Ko	711 8.4 Jo	721 11.0 Jo
733 10.9 B	737 6.9 Ko	731 12.7 Hu	735 9.0 Jo	714 8.5 Jo	725 12.1 Pt
734 10.7 Th	737 7.0 Ma	733 12.9 B	738 10.0 Ko	716 9.0 Th	735 11.8 Jo
735 11.2 Gy	743 6.8 GD	737 13.3 Wn	739 10.2 Bw	720 8.9 Ko	741 11.2 B
735 10.7 Jo	S Tuc	739 13.5 Bw	739 9.8 Bo	721 8.5 Jo	U Per
T Cas	*001862*	RW And	742 8.3 Wy	726 8.6 Ko	015254
001755	704 13.2 En	004132	743 9.6 Bo	729 8.7 Jo	680 8.4 Ch
676 9.1 Ch	707 12.3 Bl	689 11.4 Ch	744 9.3 B	731 8.8 Jo	715 9.1 Ry
691 9.0 Ch	721 10.9 Sl	707 9.1 Jo	749 9.4 Bo	734 9.1 Th	721 9.5 Ry
706 8.7 Jo	S Cet	710 9.0 Jo	750 9.4 Bo	735 9.0 B	725 9.5 Bo
706 7.8 Mp	*001909*	716 9.5 Th	754 9.5 Bw	735 8.8 Jo	725 9.3 Pt
711 8.6 Jo	671 9.6 Ch	717 8.9 Jo	U Tuc	737 9.1 Ko	726 9.6 Ry
714 8.6 Jo	705 11.5 Ch	720 8.8 Jo	*005475*	742 9.5 Wy	727 9.6 Bo
716 8.6 Th	706 11.3 Mp	731 8.8 Jo	681 8.1 Bl	U Psc	731 10.0 Ry
717 8.6 Jo	706 12.0 Jo	731 9.1 Hi	683 8.4 En	011712	732 9.8 Bo
720 8.6 L	710 12.3 Jo	734 8.9 Th	688 8.4 En	725 11.8 Pt	736 9.9 B
721 8.7 Jo	720 12.3 L	735 8.7 Jo	688 8.2 Bl	732 12.6 L	737 10.1 Bw

Variable Star Observations Received During February, 1932.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
U Per			T Per			R Cet			R Tri			X Cet			T Tau		
015254			021258			*022000*			023133			*031401*			041619		
739	10.0	Bo	749	8.9	Bo	676	8.2	Ch	735	9.0	Gy	690	9.6	Ch	653	10.1	Hr
742	10.1	Wy	750	9.0	Bo	683	8.4	Ch	736	8.8	Ah	706	10.6	Jo	731	10.6	Hr
743	10.2	Bo	Z Cep			701	8.9	Ch	737	8.6	Ma	714	10.7	Jo	735	10.5	Hr
746	10.1	Bw	021281			706	8.6	Jo	737	9.2	Wd	721	10.8	Jo	R Tau		
749	10.5	Bo	677	[11.5	Ch	711	8.8	Jo	746	8.6	Sf	721	11.2	L	042209		
750	10.8	Bo	707	[12.5	Mp	721	10.4	L	751	8.2	Wd	725	11.6	Pt	725	13.4	Pt
XX Per			744	[13.5	B	727	10.4	Bg	T Ari			725	11.9	Hu	737	14.1	Ma
015654			o Cet			732	10.9	L	024217			732	11.7	L	737	12.3	Wn
680	8.0	Ch	*021403*			RR Per			721	10.6	Ko	742	12.5	Wy	W Tau		
S Ari			683	9.5	En	022150			731	10.4	Me	Y Per			042215		
015912			688	9.3	Ch	680	11.5	Ch	734	10.4	Ko	032043			687	10.5	Ch
720	13.7	L	701	9.1	Ch	723	12.8	L	737	10.6	Ko	680	10.4	Ch	707	10.5	Jo
732	12.9	L	702	8.7	Sl	733	13.1	B	743	10.3	Me	704	10.2	Ch	711	9.9	Jo
735	12.6	B	704	9.0	En	736	12.5	L	W Per			708	10.4	Ah	720	9.8	Jo
R Ari			706	9.0	Jo	739	13.0	Bw	024356			714	10.4	Ah	722	10.6	L
021024			708	9.1	Ah	746	13.2	Bw	693	10.8	Ch	721	9.5	Ko	725	10.0	Pt
683	10.9	Ch	711	8.6	Jo	R For			715	11.0	Ry	725	9.4	Bo	731	9.8	Jo
708	9.6	Ah	712	8.7	Sl	*022426*			721	10.7	Ry	725	9.8	Pt	734	10.8	L
714	9.4	Ah	714	9.2	Ah	681	10.4	Bl	725	10.7	Pt	726	9.2	Ko	735	10.0	Jo
719	9.2	Ah	716	8.6	Sl	688	10.5	Bl	726	10.7	Ry	727	9.6	Bo	737	10.5	Cy
720	8.7	Ah	717	8.7	Jo	700	9.5	Bl	729	9.6	Jo	729	9.4	Jo	739	9.4	Bw
721	9.2	L	720	8.6	Jo	707	9.0	Bl	731	10.2	Ry	732	9.5	Bo	743	10.5	Cy
725	8.9	GD	720	9.2	Ah	U Cet			733	9.6	B	734	9.0	Ko	744	11.1	Wy
725	9.5	Pt	721	9.1	L	*022813*			734	10.6	Ko	735	9.1	Jo	748	10.6	Cy
726	8.8	Ah	725	9.0	Wd	683	6.8	Ch	735	9.4	Jo	738	9.3	Ko	S Tau		
727	8.9	Ah	725	8.9	Pt	701	7.8	Ch	736	11.0	Hl	739	9.4	Bo	042309		
728	8.5	Ah	725	9.1	Bo	706	9.0	Jo	737	10.4	Cy	742	9.0	Wy	687	[13.0	Ch
729	8.7	Jo	727	9.0	Bo	711	9.1	Jo	738	10.6	Ko	743	9.2	Bo	725	14.1	Pt
732	8.9	L	732	9.0	Bo	722	8.3	L	739	9.6	Bw	749	9.2	Bo	737	[13.5	Wn
735	8.6	Jo	732	9.2	Sf	725	8.5	Pt	740	10.7	Hl	750	9.2	Bo	T Cam		
735	8.7	Ah	732	8.7	L	725	8.7	Bo	742	10.2	Wy	R Per			043065		
736	8.8	Ah	735	8.9	Gy	727	8.7	Bo	743	9.9	Cy	032335			677	9.6	Ch
737	9.0	Ma	735	8.6	Jo	732	8.7	Bo	748	9.9	Cy	680	9.2	Ch	705	10.5	Ch
738	9.2	Wy	735	9.1	Ah	732	9.0	L	R Hor			722	11.8	L	707	10.5	Jo
741	8.7	B	736	9.3	Ah	735	9.0	Gy	*025050*			725	11.3	Pt	721	12.0	Jo
743	8.5	GD	737	8.6	Cy	739	8.7	Bo	681	12.4	Bl	733	12.8	B	721	11.0	L
W And			737	9.1	Sf	750	8.8	Bo	683	12.4	En	733	12.9	Mg	725	11.0	Bo
021143a			737	9.1	Ma	RR Cep			688	12.5	Bl	735	12.9	L	725	12.0	Pt
725	12.8	Pt	739	8.9	Bo	022980			702	12.6	Sl	737	12.8	Wn	727	11.2	Bo
733	[13.5	B	746	8.9	Sf	707	12.6	Mp	703	12.5	Bl	737	12.5	Ma	732	11.5	Bo
735	[12.2	Gy	750	8.7	Bo	746	10.7	Ie	706	12.5	En	742	13.1	Wy	732	12.1	Mp
737	[13.6	Wn	751	8.8	Sf	R Tri			712	12.6	Sl	Nov Per			733	11.8	L
751	[12.7	Bw	751	8.2	Cy	023133			716	12.7	Sl	032443			743	11.6	Bo
T Per			S Per			683	11.8	Ch	T Hor			725	13.3	Pt	744	12.6	Wy
021258			021558			706	10.8	Ch	*025751*			T For			750	11.9	Bo
645	9.1	Hr	708	9.6	Ah	706	10.4	Jo	681	12.6	Bl	*032528*			RX Tau		
649	9.1	Hr	725	9.6	Pt	708	10.7	Ah	683	12.3	En	716	8.9	L	043208		
652	9.1	Hr	725	9.7	Bo	711	10.0	Jo	688	12.3	Bl	729	8.8	L	689	13.5	Ch
656	9.2	Hr	727	9.7	Bo	714	10.0	Ah	702	11.0	Sl	735	8.8	L	722	13.6	L
708	8.7	Ah	732	9.6	Bo	720	9.5	Ah	703	11.0	Bl	U Eri			734	14.0	L
725	8.8	Pt	733	9.8	B	725	9.7	Pt	706	11.0	En	*034625*			737	13.7	Wn
725	9.0	Bo	737	9.5	Sz	725	9.8	Wd	712	10.2	Sl	684	9.9	En	740	13.4	B
727	8.9	Bo	739	9.6	Bo	727	9.2	Ah	716	10.0	Sl	706	10.7	En	R Ret		
731	9.0	Hr	742	9.8	Wy	731	8.9	Jo	U Ari			T Eri			*043263*		
732	9.0	Bo	743	9.6	Bo	735	8.8	Ah	030514			*035124*			681	8.3	Bl
736	8.9	Hr	749	9.6	Bo	735	8.7	Jo	733	[14.0	L	684	8.2	En	684	8.4	En
739	8.8	Bo	750	9.4	Bo	735	9.1	Sf	736	14.5	L	706	8.5	En	688	8.1	Bl
743	8.7	Bo				735	9.2	Wd							692	9.0	En

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R RET			ε AUR			R AUR			W AUR			T ORI			SU TAU		
043263			045453			050953			052036			*053005a*			054319		
703	9.8	En	769	3.4	Dg	720	8.5	Jo	732	9.3	Sf	735	10.7	Jo	680	9.7	Ch
703	9.6	Bl	777	3.0	Dg	722	8.9	Ah	734	8.8	L	736	11.0	L	682	9.7	Ch
704	9.0	Sl	779	3.0	Dg	725	9.0	Pt	734	9.3	Mg	737	10.1	L	685	9.7	Ch
712	9.6	Sl	788	2.9	Dg	728	9.2	Ah	734	9.2	Ro	737	10.4	Bw	687	9.7	Ch
721	10.1	Sl	791	3.2	Dg	735	9.3	Ah	737	9.3	Ma	737	9.9	Ma	691	9.7	Ch
X CAM			R LEP			736	9.3	Ah	737	9.4	Sf	737	10.2	Wy	694	9.7	Ch
043274			*045514*			744	9.1	Wy	740	9.8	Hi	737	10.8	Pt	703	9.7	Ch
677	8.2	Ch	676	8.4	Ch	T PIC			746	9.8	Sf	738	10.4	L	716	9.4	L
721	8.8	L	702	6.1	Sl	*051247*			S ORI			738	10.3	Me	720	9.5	Pt
725	8.8	Pt	706	6.9	Jo	681	10.3	Bl	*052404*			740	11.3	B	722	9.6	Pt
732	10.0	L	711	6.8	Jo	684	10.9	En	682	11.1	Ch	742	10.5	Pt	729	9.4	L
744	11.7	Wy	712	6.1	Sl	690	11.4	En	703	11.5	Ch	743	10.1	Me	732	9.5	L
R DOR			714	6.5	Jo	703	12.4	Bl	725	11.9	Pt	746	10.6	Bw	732	9.6	Pt
043562			720	7.0	Jo	NOV TAU			733	10.6	B	750	10.4	Pt	733	9.6	Mg
681	5.6	Bl	721	7.1	L	051316			734	11.6	Ro	AN ORI			735	9.7	Mg
684	5.6	En	725	7.1	Pt	733	14.9	L	734	11.7	Mg	*053005t*			735	9.4	L
688	5.6	Bl	731	6.8	Jo	736	14.9	L	737	11.5	Ma	737	11.4	Ma	735	9.9	Ie
692	5.6	En	734	7.0	L	737	14.9	L	744	11.8	Wy	738	11.5	Me	735	9.6	Pt
703	5.5	En	735	6.8	Jo	738	14.7	L	T ORI			S CAM			736	9.4	L
703	5.9	Bl	737	7.0	Ma	T COL			*053005a*			053068			737	9.4	L
704	5.5	Sl	V ORI			*051533*			680	10.9	Hr	688	8.5	Ch	737	9.9	Ma
712	5.6	Sl	050003			681	10.7	Bl	681	11.0	Hr	707	8.1	Jo	737	9.6	Pt
721	5.7	Sl	722	14.1	L	684	10.8	En	682	11.2	Ch	711	8.3	Jo	738	9.7	Pt
R CAE			725	13.2	Pt	690	11.0	En	685	11.3	Ch	717	8.4	Jo	738	9.5	Me
043738			734	12.8	Ro	703	11.9	En	686	11.0	Ch	721	8.5	Jo	738	9.5	L
681	8.8	Bl	734	12.7	Mg	703	11.5	Bl	687	11.1	Ch	725	9.3	Pt	739	9.6	Sf
684	9.2	En	734	12.7	L	S AUR			689	11.0	Ch	725	8.7	Bo	742	9.5	Pt
688	9.2	En	737	12.3	Wn	052034			694	11.3	Ch	727	8.6	Bo	747	9.5	Mg
692	9.5	En	T LEP			680	10.4	Ch	696	11.4	Ch	731	8.6	Jo	750	9.6	Pt
703	9.5	En	*050022*			683	10.5	Ch	703	11.4	Ch	732	8.6	Bo	751	9.7	Sf
703	9.8	Bl	681	10.9	Bl	685	10.2	Ch	706	10.7	Jo	739	8.5	Bo	S COL		
R PIC			684	11.2	En	691	10.2	Ch	710	11.0	Jo	743	8.8	Bo	054331		
044349			703	9.1	En	694	10.2	Ch	714	10.9	Jo	744	8.7	Wy	684	12.6	En
681	7.4	Bl	703	9.0	Bl	695	10.0	Ch	715	11.2	Hr	RR TAU			703	13.3	Bl
684	7.7	En	706	8.7	Jo	696	9.5	Ch	716	10.4	L	053326			Z TAU		
690	7.7	En	711	8.8	Jo	703	10.0	Ch	717	10.7	Jo	716	10.7	L	054615a		
703	7.7	En	714	8.6	Jo	706	9.9	Jo	720	10.6	Jo	721	11.0	L	689	12.6	Ch
703	7.6	Bl	720	8.2	Jo	710	9.9	Jo	720	10.7	Pt	729	10.8	L	721	13.0	L
V TAU			725	8.9	Pt	714	10.1	Jo	720	10.4	L	732	10.8	L	735	13.3	L
044617			725	8.4	Ko	720	10.0	Jo	721	10.3	L	735	10.8	L	737	13.1	Wn
689	13.2	Ch	731	8.1	Jo	725	11.5	Bo	722	10.1	L	736	10.9	L	737	13.0	Ma
704	13.4	Ch	734	8.2	Ko	732	11.6	Bo	722	10.8	Pt	737	10.9	L	RS TAU		
734	13.5	Mg	735	8.1	Jo	734	10.8	Ko	724	10.2	L	737	11.1	Wn	054615b		
735	13.6	Ie	738	8.3	Ko	738	10.8	Ko	725	10.6	Jo	738	10.8	L	737	9.0	Wn
737	13.5	Wn	740	8.5	Hl	743	11.7	Bo	729	10.3	L	RU AUR			RU TAU		
740	13.4	B	S PIC			744	11.1	Wy	730	10.3	L	053337			054615c		
744	12.5	Wy	*050848*			750	11.6	Bo	731	10.2	Hr	680	10.1	Ch	737	13.3	Wn
R ORI			681	13.1	Bl	W AUR			731	9.7	Me	721	12.0	Jo	737	13.9	Ma
045307			703	12.7	Bl	052036			731	10.5	Jo	725	12.0	Ah	R COL		
677	9.5	Ch	R AUR			680	9.5	Ch	732	10.2	L	735	12.1	Mg	*054629*		
704	9.5	Ch	050953			703	8.5	Ch	732	10.3	Pt	744	12.4	Wy	684	12.4	En
721	9.9	L	691	7.8	Ch	706	8.0	Jo	733	10.3	L	746	12.7	Bw	703	12.7	Bl
732	10.3	Sf	706	8.0	Jo	710	8.2	Jo	733	10.4	Hr	U AUR			737	12.8	Wn
734	10.2	Ro	708	8.6	Ah	714	8.4	Jo	734	10.9	Hr	053531			α ORI		
734	10.0	Mg	710	8.2	Jo	720	8.4	Jo	734	10.2	B	722	13.5	L	054907		
734	10.6	L	714	8.3	Jo	721	8.8	L	735	10.7	L	725	12.8	Ah	702	0.3	Sl
737	10.8	Sf	714	8.8	Ah	725	8.9	Pt	735	11.3	Ie	734	13.4	L	712	0.3	Sl
746	10.8	Sf	720	9.0	Ah	731	9.1	Hi	735	11.0	Pt	737	13.2	Wn	716	0.3	Sl

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
α ORI	Z AUR	S LYN	R GEM	V GEM	R CNC
054907	055353	063558	070122a	071713	081112
725 0.9 Oy	725 10.4 Pt	704 13.8 Ch	722 7.0 Ah	735 9.2 B	722 10.2 Sh
731 0.7 Oy	732 10.3 Pt	725 13.5 Pt	725 7.3 Wd	746 9.8 Bw	722 10.1 Ol
733 0.5 Mc	732 10.6 Sf	X GEM	726 7.2 Ah	S CMI	722 10.2 Wd
741 0.4 Mc	733 10.6 Mc	064030	727 7.2 Ah	072708	731 9.9 Jo
762 0.8 Dg	735 10.6 Pt	735 12.8 Ie	731 6.6 Jo	679 11.2 Ch	732 9.8 Pt
764 0.8 Dg	737 10.3 Pt	737 12.8 Wn	732 7.0 Pt	704 12.2 Ch	735 9.8 Jo
769 0.5 Dg	737 10.6 Sf	737 12.9 Ma	734 7.3 B	732 12.5 Pt	737 10.0 Wd
770 0.5 Dg	738 10.3 Pt	746 13.0 Bw	735 7.2 Bg	739 13.0 Ie	741 9.4 B
777 0.5 Dg	742 10.5 Pt	747 13.2 Mg	735 7.2 Ah	740 12.5 B	743 9.9 Cy
779 0.5 Dg	746 10.8 Sf	Y MON	735 7.4 Wd	T CMI	750 9.6 Cy
791 0.5 Dg	750 10.6 Pt	065111	735 6.7 Jo	072811	751 9.9 Wd
U ORI	R OCT	722 13.4 L	736 7.3 Ah	690[12.0 Ch	V CNC
054920a	*055686*	734 13.3 L	737 7.5 Wd	740 13.2 B	081617
676 6.0 Ch	681 10.9 Bl	735 13.4 Mg	750 7.8 Wd	Z PUP	708 10.8 Ah
685 6.0 Ch	684 10.8 En	737 13.5 Ma	Z GEM	*072820b*	714 11.5 Ah
694 6.1 Ch	703 11.2 Bl	737 13.2 Wn	070122b	685 12.1 En	722 11.7 Ol
704 6.1 Sl	704 10.8 Sl	X MON	732 12.6 Pt	S VOL	723 11.4 L
706 6.4 Jo	721 11.0 Sl	*065208*	750 12.6 Wd	*073173*	732 12.3 Pt
708 6.7 Ah	X AUR	722 7.8 L	TW GEM	684[12.8 En	733 12.3 L
710 6.6 Jo	060450	734 7.7 L	070122c	703[13.2 Bl	735 12.2 Gy
712 6.3 Sl	676 10.6 Ch	R LYN	732 8.2 Pt	U CMI	741 12.2 B
714 6.9 Ah	680 10.5 Ch	065355	R CMI	073508	743 12.0 Cy
714 6.8 Jo	684 10.4 Ch	704 10.2 Ch	070310	690 9.2 Ch	750 12.5 Cy
717 6.7 Jo	688 10.2 Ch	708 10.8 Ah	704 11.4 Ch	706 8.2 Jo	RT HYA
720 6.9 Jo	695 8.8 Ch	722 11.0 L	706 11.0 Jo	721 8.4 Jo	*082405*
720 6.9 Ah	722 8.2 L	733 11.9 L	710 10.8 Jo	722 7.9 L	716 8.2 Th
721 6.4 Sl	725 8.2 Pt	737 10.8 Ma	714 10.3 Jo	725 8.3 Jo	723 7.6 L
721 7.6 Wd	732 8.8 Sf	RS GEM	717 10.0 Jo	732 8.0 Pt	734 7.6 L
722 7.2 Ah	734 8.5 L	065530	721 10.1 Jo	734 8.2 B	734 8.0 Th
725 7.2 Pt	737 8.9 Sf	737 10.9 Ma	723 10.5 L	734 8.1 L	738 7.6 Pt
725 7.7 Hu	746 9.5 Sf	738 11.4 Me	731 9.7 Jo	S GEM	738 7.2 Ko
725 7.2 Wd	V AUR	Z CMA	732 10.5 Pt	073723	R CHA
726 7.3 Ah	061647	*065011*	734 9.5 L	737 13.9 Wn	*082476*
728 7.4 Ah	682 12.2 Ch	702 9.7 Sl	735 9.4 Jo	747[13.8 Mg	681 10.0 Bl
731 7.6 Jo	721 11.2 L	712 9.8 Sl	737 10.0 Sf	W PUP	684 9.9 En
731 7.4 Oy	734 11.6 L	716 9.9 Sl	740 9.6 B	*074241*	690 9.9 En
731 7.4 Hu	735 11.6 Mg	V CMI	751 9.5 Sf	681 10.8 Bl	703 10.6 En
733 7.5 Mc	V MON	070109	R VOL	684 11.2 En	703 10.9 Bl
735 7.6 Ah	*061702*	680 10.0 Ch	*070772*	690 11.7 En	704 10.2 Sl
736 7.7 Ah	682 12.2 Ch	704 12.1 Ch	684[13.4 En	703 12.6 En	721 11.2 Sl
737 7.9 Wd	725 12.5 Pt	706 12.0 Jo	L2 PUP	703 12.6 Bl	U CNC
744 7.7 B	735 13.1 Mg	722 13.2 L	*071044*	T GEM	083019
750 8.7 Wd	737 13.3 Wn	732 13.5 Pt	702 4.5 Sl	074323	722 14.6 Ol
769 6.0 Dg	AG AUR	734 13.3 L	712 4.8 Sl	682 11.3 Ch	724 14.1 L
V CAM	062047	R GEM	721 5.1 Sl	737 13.6 Wn	735 14.0 L
054974	721 9.4 L	070122a	RR MON	747 14.0 Mg	741 13.8 B
688 11.2 Ch	734 8.7 L	680 7.2 Ch	071201	U PUP	X UMA
721 12.1 L	R MON	693 6.9 Ch	690[11.8 Ch	*075612*	083350
725 11.9 Pt	063308	706 6.9 Jo	723[13.2 L	740 13.5 B	706 12.0 Jo
733 12.2 L	689 12.8 Ch	708 6.9 Ah	734[14.2 L	753 11.7 Bw	711 11.7 Jo
739 13.7 B	694 12.8 Ch	710 6.4 Jo	V GEM	R CNC	714 10.9 Jo
Z AUR	695 12.8 Ch	714 6.8 Jc	071713	081112	717 10.2 Jo
055353	704 12.6 Ch	714 7.0 Ah	690 9.3 Ch	706 10.2 Jo	720 10.0 Jo
706 10.4 Jo	735 12.7 Mg	717 6.7 Jo	708 8.4 Ah	707 10.5 Ch	731 9.7 Jo
711 10.2 Jo	NOV PIC	720 6.7 Jo	714 8.6 Ah	708 10.8 Ah	735 9.5 Jo
714 9.9 Jo	*063462*	721 6.7 Wd	723 8.8 L	711 10.1 Jo	737 9.8 Wy
720 10.4 Pt	684 8.5 En	722 7.0 Wd	732 9.1 Pt	714 10.2 Ah	744 9.5 B
722 10.3 Pt	703 8.5 En	722 7.2 Sh	734 8.9 L	717 10.0 Jo	

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S HYA	R CAR	Z VEL	RS CAR	T CVN	S UMA
084803	*092962*	*094953*	*110361*	122532	123961
707 11.5 Ch	684 8.9 En	718 8.5 Sl	718[12.3 Sl	750 9.8 Cy	735 8.6 Wd
722 11.2 Ol	690 9.0 En	721 8.4 Sl	S LEO	Y VIR	735 8.4 Ah
735 10.1 Pt	703 9.6 En	V LEO	110506	*122803*	736 8.4 Ah
741 10.5 B	702 9.1 Sl	095421	722 11.4 L	722 13.5 L	737 8.2 Wd
T HYA	703 9.0 Bl	707[13.5 Ch	734 11.7 L	735 12.5 L	737 8.6 Sz
085008	712 9.2 Sl	RR CAR	737 12.3 Wn	737 12.1 Ma	738 8.7 Pt
707 8.5 Ch	718 9.1 Sl	*095458*	738 11.7 Pt	U CEN	750 8.1 Wd
722 9.8 Ol	X HYA	684 8.2 En	743 11.6 Cy	*122854*	RU VIR
723 9.4 L	*093014*	RV CAR	750 12.1 Cy	703 8.7 Bl	124204
734 9.7 L	707 9.6 Ch	*095563*	RY CAR	T UMA	711 13.3 L
738 10.0 Pt	735 10.9 Gy	684[12.5 En	*111561*	123160	724 12.7 L
744 10.4 B	744 10.9 B	703[13.1 Bl	703[13.1 Bl	695 8.7 Ch	732 12.7 L
T CNC	Y DRA	S CAR	706[13.1 En	706 9.7 Jo	738 13.5 Pt
085120	093178	*100661*	RS CEN	708 9.9 Ah	751 12.5 Cy
688 9.0 Ch	711 14.3 L	681 6.3 Bl	*111661*	710 9.9 Jo	U VIR
707 8.0 Jo	735 14.0 L	684 6.5 En	681 9.1 Bl	714 9.7 Jo	124606
710 8.0 Jo	R LMI	690 6.5 En	684 9.3 En	714 10.2 Ah	708 10.5 Ah
717 8.4 Jo	093934	702 5.5 El	690 9.1 En	722 10.9 Wd	711 11.1 L
721 8.3 Jo	707 11.9 Ch	703 5.5 Bl	703 9.4 Bl	722 10.8 Sh	724 10.4 L
731 8.5 Jo	735 12.1 Gy	703 6.0 En	706 9.9 En	725 10.8 Wd	732 9.5 L
735 8.5 Jo	735 12.0 Pt	712 5.4 Sl	X CEN	731 11.3 Jo	738 9.6 Pt
735 8.5 Pt	737 11.2 Sz	721 5.5 Sl	*114441*	735 11.6 Jo	RV VIR
737 9.4 Wy	RR HYA	Z CAR	703[11.8 Bl	735 11.4 Ah	*130213*
741 9.1 B	*094023*	*101058a*	W CEN	735 11.7 Wd	723 13.8 L
T PYX	737 13.5 Wn	684[12.3 En	*115058*	735 10.9 Gy	732 13.3 L
090031	R LEO	703 12.2 Bl	681 9.6 Bl	738 11.4 Pt	751 11.4 Cy
703 [t Bl	094211	W VEL	703 11.1 Bl	R VIR	U OCT
V UMA	707 8.2 Ch	*101153*	R COM	123307	*131283*
090151	707 8.5 Jo	684[12.0 En	115919	688 6.7 Ch	680 8.9 Bl
711 10.1 L	708 8.6 Ah	703[13.0 Bl	695[13.0 Ch	708 7.0 Ah	703 8.3 Bl
725 10.0 L	711 8.4 Jo	U HYA	750[12.5 Cy	737 8.5 Ma	V CVN
733 9.8 L	714 8.4 Ah	*103212*	SU VIR	738 8.6 Pt	131546
733 10.0 Mc	717 8.2 Jo	369 5.7 Km	120012	740 8.2 Hl	736 9.7 GD
737 10.2 Sf	722 7.8 Ah	422 5.4 Km	695 10.4 Ch	RS UMA	738 9.8 GD
746 10.1 Sf	722 8.6 Wd	439 5.5 Km	722 11.9 L	123459	743 9.7 GD
W CNC	725 8.2 Wd	R UMA	734 12.3 L	715[12.6 Ry	V VIR
090425	733 8.0 Mc	103769	738 12.8 Pt	721[12.6 Ry	*132202*
707 13.8 Ch	735 7.1 Ah	707 12.5 Ch	T VIR	735[11.8 Gy	711 8.4 L
723 13.6 L	735 8.0 Pt	738 12.4 Pt	120905	S UMA	724 8.2 L
735 14.4 L	735 7.0 Jo	743 12.7 Cy	722 10.9 L	123961	732 8.3 L
737 13.9 Wn	737 7.3 Wd	746 13.0 Ie	732 11.2 L	695 10.8 Ch	737 8.3 Ma
RX UMA	737 6.7 Sz	750 12.8 Cy	R CRV	706 10.0 Jo	R HYA
090567	741 7.6 Mc	750 12.6 Wd	*121418*	708 10.0 Ah	*132422*
711 10.8 L	743 6.8 Me	V HYA	712 11.5 Sl	710 9.4 Jo	692 8.5 Ch
725 10.9 L	750 6.5 Wd	*104620*	721 12.2 Sl	714 9.4 Jo	711 8.1 L
733 10.8 L	L CAR	698 7.0 Ch	722 11.9 L	714 9.5 Ah	716 7.6 Sl
RW CAR	*094262*	703 6.4 Bl	725 12.0 Jo	720 8.9 Ah	720 8.0 Pt
091868	702 3.5 Sl	721 6.2 L	733 12.3 L	722 8.8 Ah	724 7.7 L
684[12.8 En	718 4.0 Sl	732 6.5 L	SS VIR	722 8.8 Sh	732 6.9 L
703 12.6 Bl	Y HYA	738 6.3 Pt	*122001*	722 8.6 Wd	S VIR
Y VEL	*094622*	RS HYA	711 7.8 L	725 8.7 Sh	*132706*
092551	738 6.8 Pt	*104628*	724 8.0 L	725 8.7 Wd	692 12.0 Ch
681 11.2 Bl	Z VEL	703 10.4 Bl	732 8.4 L	726 8.6 Ah	716 12.3 Sl
684 11.8 En	*094953*	W LEO	T CVN	727 8.5 Ah	720 12.2 Pt
703 12.0 Bl	681 11.7 Bl	104814	122532	731 8.5 Wd	RV CEN
R CAR	684 11.5 En	722 13.9 Ol	695 11.2 Ch	731 8.4 Jo	*133155*
092962	702 10.0 Sl	735 13.4 L	737 9.9 Cy	735 8.0 Jo	703 7.2 Bl
681 8.9 Bl	703 9.7 Bl	737 13.6 Wn	738 9.9 Pt	735 8.6 Gy	

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T UMi	RS Vir	S Lib	R CrB	X Sco	R UMi
133273	142205	*151520*	154428	*160221a*	163172
706 11.0 Jo	722 10.5 L	711 8.7 L	708 6.4 Ah	724 10.8 L	720 9.8 Jo
711 10.7 Jo	734 11.2 L	725 9.3 L	711 6.0 L	734 11.0 L	721 10.2 L
714 10.5 Jo	V Boo	733 9.3 L	721 6.0 L	SX Her	725 9.6 Jo
720 10.0 Jo	142539a	S Ser	722 6.0 L	160325	731 9.5 Jo
723 11.5 L	695 10.3 Ch	151714	723 6.0 L	721 8.0 L	734 10.4 L
731 9.7 Jo	708 8.9 Ah	695 11.0 Ch	724 6.0 L	725 8.0 Pt	R Dra
734 9.6 L	714 8.7 Ah	723 11.9 L	725 6.1 L	732 7.9 L	163266
735 9.5 Jo	720 9.0 Pt	734 11.9 L	725 6.2 Pt	750 8.0 Pt	676 11.2 Ch
T Cen	725 8.3 Jo	S CrB	732 6.0 L	RU Her	706 12.0 Jo
133633	735 8.3 Jo	151731	733 6.0 L	160625	710 11.8 Jo
716 6.9 Sl	735 8.3 Ah	685 6.7 Ch	734 6.0 L	721 13.6 L	714 11.7 Jo
R CVn	737 8.3 Cy	698 7.7 Ch	735 6.1 L	735 14.0 L	714 11.5 Ah
134440	743 7.9 Cy	720 8.5 Pt	736 6.0 L	R Sco	717 11.7 Jo
708 8.7 Ah	750 8.2 Cy	RS Lib	737 6.0 L	*161122a*	720 11.4 Jo
714 8.5 Ah	R Cam	*151822*	737 5.9 Cy	725 12.7 Pt	725 10.0 Jo
720 8.3 Pt	142584	722 9.2 L	737 6.1 Pt	S Sco	725 10.7 Pt
735 8.1 Ah	706 8.7 Ch	733 9.8 L	738 6.2 Pt	*161122b*	735 9.9 Jo
735 7.8 Gy	714 8.4 Th	RU Lib	743 5.9 Cy	725 13.3 Pt	735 10.3 Gy
T Aps	716 8.6 Th	*152714*	748 5.8 Cy	W CrB	735 9.6 Ah
134677	731 8.2 Th	711 9.6 L	750 5.8 Cy	161138	750 9.3 Wd
680 12.5 Bl	734 8.2 Th	720 9.4 Pt	750 6.1 Pt	725 10.7 Pt	RR Oph
703 10.3 Bl	R Boo	725 9.9 L	751 5.9 Cy	W Oph	*164319*
Z Boo	143227	733 10.2 L	X CrB	*161607*	723[12.5 L
140113	695 8.5 Ch	X Lib	154536	723 12.2 L	734[13.6 L
695 10.2 Ch	708 9.3 Ah	*153020*	723 13.4 L	725 12.0 Pt	S Her
722 9.1 L	714 9.8 Ah	736 12.8 L	734 13.3 L	733 12.5 L	164715
734 9.0 L	720 10.4 Pt	W Lib	R Ser	V Oph	725 9.8 Pt
737 9.1 Ma	725 10.7 Jo	*153215*	154615	*162112*	RR Sco
Z Vir	V Lib	724 11.2 L	698 7.0 Ch	723 8.7 L	*165030a*
140512	*143417*	734 10.8 L	720 7.0 Pt	725 9.0 Pt	716 5.7 Sl
722 13.6 L	711 9.7 L	S UMi	V CrB	733 8.9 L	SS Oph
735[13.2 L	725 10.1 L	153378	154639	U Her	*165202*
R Cen	734 10.2 L	676 11.2 Ch	720 8.5 Pt	162119	725 12.1 Pt
140959	S Lup	708 11.8 Ah	R Lib	692 9.7 Ch	RV Her
703 8.4 Bl	*144646a*	714 12.0 Ah	*154715*	698 9.0 Ch	165631
716 7.0 Sl	716 8.8 Sl	717 10.8 Jo	723 13.8 L	725 8.4 Pt	721 12.2 L
U UMi	U Boo	720 11.0 Jo	735[13.8 L	725 8.0 Jo	725 13.5 Pt
141567	144918	720 11.8 Pt	RR Lib	SS Her	732 13.5 L
706 10.8 Jo	693 11.1 Ch	725 11.2 Jo	*155018*	162807	R Oph
708 10.9 Ah	S Aps	735 11.5 Jo	723 13.1 L	721 9.6 L	*170215*
711 10.5 Jo	*145971*	735 11.6 Gy	734 13.5 L	725 9.1 Pt	723 7.8 L
714 10.3 Jo	681 10.7 Bl	738 11.8 Ko	Z CrB	732 9.1 L	725 8.0 Pt
714 10.7 Ah	687 10.7 Bl	R CrB	155229	T Oph	733 7.8 L
720 9.6 Jo	698 10.7 Bl	154428	722 9.7 L	*162815*	RT Her
720 10.6 Pt	703 10.9 Bl	327 6.0 Km	734 10.1 L	723 13.0 L	170627
731 9.0 Jo	716 11.1 Sl	337 6.0 Km	RZ Sco	733 13.0 L	725 14.2 Pt
735 8.8 Jo	RT Lib	414 6.0 Km	*155823*	S Oph	Z Oph
735 9.3 Ah	*150018*	422 6.1 Km	720 10.8 Pt	*162816*	171401
736 9.5 Ah	720 12.8 Pt	428 6.0 Km	Z Sco	736 14.0 L	724 11.0 Wy
737 9.2 Sz	T Lib	440 6.0 Km	*160021*	W Her	725 11.5 Pt
750 8.8 Cy	*150519*	450 6.0 Km	723 11.8 L	163137	RS Her
S Boo	723[14.0 L	466 6.0 Km	733 11.8 L	725 13.5 Pt	171723
141954	735[13.2 L	507 5.7 Km	R Her	R UMi	725 8.3 Pt
695 13.3 Ch	Y Lib	623 6.0 Km	160118	163172	S Oct
724 11.8 L	*150605*	628 5.9 Km	720 9.1 Pt	706 10.0 Jo	*172486*
734 11.3 L	720 12.6 Pt	688 6.2 Ch	U Ser	710 9.9 Jo	681 12.1 Bl
735 11.4 Gy	722 12.2 L	693 6.2 Ch	160210	714 9.9 Jo	687 11.7 Bl
	733 12.7 L	698 6.2 Ch	720 12.2 Pt	717 9.8 Jo	698 10.9 Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S OCT	W LYR	ST SGR	TY SGR	RV AQL	χ CYG
172486	181136	*185512a*	*191124*	193509	194632
706 10.8 Sl	725 10.3 Pt	676 10.0 Ch	681 10.6 Bl	720 10.8 Pt	706 7.8 Jo
707 10.0 Bl	732 10.0 L	Z LYR	S SGR	724 11.5 L	708 9.1 Ah
721 8.8 Sl	RV SGR	185634	*191319a*	735 12.7 L	710 8.4 Jo
RU OPH	*182133*	716 13.2 L	675 11.0 Ch	T PAV	714 8.6 Jo
172809	681 12.2 Bl	733 13.0 L	TZ CYG	*193972*	720 9.9 Jo
723 10.2 L	SV HER	RT LYR	191350	681 12.6 En	720 9.3 Pt
725 10.4 Pt	182224	185737	725 10.5 Pt	690 11.5 En	720 9.7 Ah
732 10.9 L	724 12.8 L	684 13.0 Ch	U LYR	707 9.4 Bl	726 10.4 Jo
RT SER	734 11.6 L	716 11.2 L	191637	RT CYG	727 9.8 Bg
173411	T SER	732 10.0 L	706 9.8 Jo	194048	S PAV
724 12.6 L	182306	R AQL	711 9.9 Jo	673 8.6 Ch	*194659*
RU SCO	676[11.5 Ch	190108	714 10.1 Jo	687 7.4 Ch	681 8.7 En
173543	SV DRA	676 7.2 Ch	720 10.4 Jo	701 6.8 Ch	690 8.7 En
681 9.5 Bl	183149	V LYR	725 10.3 Pt	706 6.8 Jo	RR SGR
W PAV	724 14.3 L	190529a	AF CYG	708 7.0 Ah	*194929*
174162	733[13.9 L	684[12.9 Ch	192745	710 6.8 Jo	681 11.6 Bl
707[10.9 Bl	RZ HER	RX SGR	708 7.3 Ah	714 7.1 Ah	681 11.8 En
RY HER	183225	*190818*	714 7.4 Ah	714 6.7 Jo	688 11.1 Bl
175519	716 11.0 L	675[12.4 Ch	720 7.1 Ah	717 6.7 Jo	RU SGR
724 13.4 L	732 9.7 L	RW SGR	722 7.4 Ah	720 7.0 Jo	*195142*
725 13.5 Pt	X OPH	*190819a*	726 7.4 Ah	720 7.3 Ah	681[12.5 En
736 13.9 L	183308	675 9.4 Ch	727 7.3 Ah	720 7.0 Pt	707[11.3 Bl
V DRA	676 8.7 Ch	S LYR	728 7.4 Ah	721 7.0 Wd	RR AQL
175654	723 7.7 L	190925	735 7.3 Ah	722 7.3 Ah	*195202*
716 13.6 L	725 8.0 Pt	716 12.0 L	736 7.4 Ah	725 6.7 Wd	675 12.8 Ch
725 13.9 Pt	733 7.1 L	734 12.3 L	TY CYG	726 7.4 Jo	735 9.3 L
732 13.6 L	RS DRA	X LYR	192928	726 7.3 Ah	RS AQL
R PAV	184074	190926	722 11.8 L	727 7.4 Ah	*195308*
180363	676 10.8 Ch	725 9.0 Pt	725 11.7 Pt	728 7.4 Ah	675 13.1 Ch
681 11.4 En	RY LYR	RS LYR	732 11.7 L	731 7.6 Jo	Nov CYG
T HER	184134	190933a	RT AQL	733 7.7 Mc	195553
180531	685 13.0 Ch	684 11.2 Ch	193311	735 8.2 Gy	687[13.1 Ch
708 9.6 Ah	717 11.8 L	716 11.1 L	675 11.8 Ch	735 7.8 Ah	725[12.2 Pt
716 11.0 L	725 11.2 Pt	725 11.0 Pt	724[13.2 L	735 7.5 Jo	RR TEL
725 11.6 Pt	732 11.4 L	732 11.1 L	R CYG	736 7.7 Ah	*195656*
732 12.4 L	R SCT	RU LYR	193449	741 8.3 Mc	681[12.6 En
W DRA	*184205*	190941	687 8.4 Ch	TU CYG	Z CYG
180565	623 6.1 Hr	684 12.5 Ch	703 9.4 Ch	194348	195849
716 13.1 L	642 6.2 Hr	U DRA	706 8.7 Jo	703 13.3 Ch	680 11.3 Ch
725 13.9 Pt	644 6.0 Hr	190967	708 9.6 Ah	716 12.5 L	703 13.0 Ch
733 13.8 L	645 5.9 Hr	684 13.0 Ch	710 8.8 Jo	721 11.6 Ry	732 13.1 L
X DRA	652 5.6 Hr	725 13.3 Pt	714 9.0 Jo	724 11.6 Ry	S TEL
180666	675 5.6 Ch	732 14.3 L	714 10.0 Ah	725 12.0 Pt	*195855*
716 12.3 L	721 5.0 L	W AQL	717 9.3 Jo	732 10.9 L	681[12.6 En
733 13.1 L	732 5.2 L	*191007*	720 9.4 Jo	737 9.6 Jo	707[12.0 Bl
TV HER	Nov AQL	675[13.6 Ch	720 9.6 Pt	739 9.5 Jo	SY AQL
181031	184300	737[12.6 L	720 9.7 Ah	744 9.5 Jo	200212
716 10.7 L	676 10.7 Ch	T SGR	721 9.6 Wd	750 9.0 Jo	675 9.7 Ch
732 12.0 L	β LYR	*191017*	725 9.5 Wd	X AQL	720 11.0 Pt
RY OPH	184633	675 11.0 Ch	726 9.6 Jo	194604	722 11.1 L
181103	764 3.5 Dg	R SGR	731 9.8 Jo	675 11.0 Ch	737 12.2 L
725 10.3 Pt	770 4.1 Dg	*191019*	733 10.5 Mc	737 13.1 L	S CYG
W LYR	776 3.1 Dg	675 8.4 Ch	735 10.4 Gy	χ CYG	200357
181136	RX LYR	RY SGR	735 9.9 Jo	194632	686 10.1 Ch
711 10.6 Jo	185032	*191033*	741 11.0 Mc	673 7.5 Ch	703 11.4 Ch
714 9.7 Jo	725 12.4 Pt	681 9.2 Bl	RV AQL	687 8.1 Ch	720 12.0 Pt
716 10.2 L		681 9.5 En	193509	705 9.5 Ch	
717 9.5 Jo		688 9.1 Bl	675 9.4 Ch		

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R CAP	WX CYG	R MIC	X DEL	T CEP	W CYG
200514	201437b	*203429*	205017	210868	213244
685 11.2 Ch	703 12.4 Ch	699 10.4 Bl	684 12.3 Ch	720 6.1 Pt	711 6.6 L
S AQL	712 12.1 L	Y DEL	712 13.2 L	721 6.5 Sh	722 6.6 L
200715a	720 12.5 Pt	203611	721 13.6 L	721 6.5 Wd	725 6.3 Oy
706 9.4 Jo	724 12.5 L	686 13.6 Ch	RR CAP	722 6.5 Wd	733 6.5 L
711 9.3 Jo	732 12.5 L	722 11.9 L	*205627*	722 6.5 Sh	S CEP
714 9.5 Jo	U CYG	733 11.2 L	685 11.4 En	722 6.2 Ah	213678
720 9.3 Pt	201647	S DEL	R VUL	725 6.5 Sh	677 9.6 Ch
RW AQL	673 7.7 Ch	203816	205923a	725 5.6 Hu	711 8.4 Jo
200715b	693 7.9 Ch	684 9.8 Ch	684 12.1 Ch	725 6.6 Wd	714 8.5 Jo
706 9.9 Jo	706 7.8 Jo	706 10.4 Jo	706 9.9 Jo	725 5.4 Jo	716 9.5 Th
711 9.8 Jo	708 8.4 Ah	711 10.0 Jo	710 9.2 Jo	726 6.4 Sh	717 8.6 Jo
714 9.8 Jo	710 7.8 Jo	714 9.6 Jo	714 8.8 Jo	726 6.2 Ah	720 8.5 Jo
720 9.0 Pt	714 7.6 Jo	717 9.7 Jo	717 8.7 Jo	727 6.4 Ah	720 8.5 Pt
R TEL	714 7.8 Ah	720 9.5 Pt	720 9.3 Pt	727 6.4 Sh	726 8.6 Jo
200747	717 7.6 Jo	V CYG	721 8.5 Jo	728 6.3 Ah	731 8.7 Jo
681[12.4 En	720 7.5 Jo	203847	729 7.8 Jo	731 5.7 Jo	731 9.8 Hu
707[11.5 Bl	720 7.7 Ah	673 9.5 Ch	731 7.5 Jo	731 6.0 Th	734 9.6 Th
RU AQL	720 7.5 Pt	693 9.7 Ch	V CAP	731 6.5 Sh	735 8.8 Jo
200812	721 7.8 Wd	706 9.1 Jo	*210124*	731 5.4 Hu	737 9.6 Cy
732 13.0 L	722 7.6 Ah	710 8.9 Jo	681 13.0 Bl	732 6.5 Sh	746 8.5 Sh
Z AQL	725 7.7 Wd	714 9.1 Jo	TW CYG	734 6.4 Sh	747 8.5 Sh
200906	726 7.4 Jo	716 10.0 L	210129	734 5.8 Th	RU CYG
675 10.3 Ch	727 7.7 Wd	717 8.9 Jo	712 14.1 L	735 6.3 Ah	213753
R SGE	727 7.5 Ah	720 9.5 Pt	732 14.4 L	735 5.7 Jo	708 8.0 Ah
200916	731 7.4 Jo	721 9.5 Jo	X CAP	735 6.4 Sh	714 8.2 Ah
706 10.5 Jo	732 8.0 Sf	726 9.8 Jo	*210221*	735 6.5 Wd	714 7.8 Jo
711 10.4 Jo	733 8.0 Mc	729 10.4 L	685[12.7 En	735 6.4 Gy	715 7.9 Ry
714 10.2 Jo	735 7.5 Jo	Y AQR	X CEP	736 6.3 Ah	716 8.2 Th
RS CYG	735 7.5 Ah	*203905*	210382	737 6.5 Sh	717 7.6 Jo
200938	736 7.6 Ah	677 9.9 Ch	737 10.9 Ch	738 6.5 Sh	720 8.1 Ah
673 7.2 Ch	741 7.8 Mc	720 10.9 Pt	706 11.4 Ch	746 6.5 Sh	720 8.1 Pt
680 7.2 Ch	744 7.5 Mc	T DEL	RS AQR	747 6.5 Sh	721 7.8 Ry
687 7.2 Ch	U MIC	204016	*210504*	RR AQR	722 8.2 Ah
701 7.2 Ch	*202240*	684 9.6 Ch	712 11.3 L	*210003*	727 8.1 Ah
705 7.2 Ch	685[13.0 En	704 9.3 Ch	720 11.4 Pt	685 14.0 Ch	731 7.8 Jo
706 7.1 Jo	707[11.1 Bl	720 9.5 Pt	Z CAP	711 13.6 L	734 8.9 Th
710 7.2 Jo	RU CAP	722 9.5 L	*210516*	720 12.5 Pt	735 7.8 Jo
712 7.5 L	*202622*	732 9.5 L	711 12.1 L	X PEG	735 8.3 Ah
714 7.3 Jo	683 11.3 En	V AQR	R EQU	211614	736 8.4 Ah
720 7.1 Pt	Z DEL	204102	210812	712 11.2 L	RV CYG
720 7.9 Wd	202817	722 8.9 L	712 13.4 L	720 10.2 Pt	213937
721 7.3 Jo	722 11.9 L	V DEL	724 13.2 L	724 10.2 L	720 6.3 Pt
724 7.3 L	733 11.7 L	204318	733 13.0 L	732 9.8 L	RR PEG
725 7.9 Wd	ST CYG	736 11.9 L	T CEP	T CAP	214024
726 7.4 Sh	202954	T AQR	210868	*211615*	720 13.2 Pt
727 7.4 Sh	686 13.8 Ch	*204405*	677 6.9 Ch	681 11.8 Bl	R GRU
731 7.3 Jo	716 12.3 L	703 11.7 Ch	693 6.2 Ch	685 12.0 Ch	*214247*
732 7.3 Sh	720 13.5 Pt	720[11.8 Pt	705 6.0 Ch	711 13.3 L	680 8.2 En
732 7.2 L	733 12.1 L	RZ CYG	706 6.0 Jo	S MIC	681 8.0 Bl
737 8.0 Cy	V VUL	204846	708 6.3 Ah	*212030*	685 8.1 En
R DEL	203226	720 12.8 Pt	711 6.0 Jo	681 9.2 Bl	688 8.1 En
201008	720 8.8 Pt	S IND	714 5.8 Jo	681 8.9 En	688 7.4 Bl
720 11.2 Pt	R MIC	*204954*	714 6.1 Ah	688 9.2 Bl	690 8.0 En
SX CYG	*203420*	681 12.0 En	716 6.0 Th	699 9.4 Bl	699 7.3 Bl
201130	681 9.3 Bl	707[11.7 Bl	719 6.2 Ah	703 9.7 En	703 8.0 En
687[13.1 Ch	683 9.0 En		720 6.3 Ah	707 9.6 Bl	707 7.4 Bl
	688 9.5 Bl		720 5.6 Jo		

Variable Star Observations Received During February, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Peg	S Gru	RW Peg	W Peg	ST And	R Tuc
215605	221948	225914	231425	233335	*235265*
685 8.8 Ch	680 12.3 En	724 8.9 L	729 11.7 L	727 10.0 Bo	681[12.9 En
711 10.5 L	685 12.3 En	731 9.0 Jo	733 11.6 Mg	731 9.2 Jo	R Cas
720 10.4 Pt	688 12.5 En	733 9.1 L	S Peg	732 10.1 Bo	235350
729 11.3 L	703 12.6 En	735 9.4 Jo	231508	733 9.5 Mg	686 12.4 Ch
U PsA	RV Peg	736 9.9 B	685 9.6 Ch	733 9.4 B	**707** 10.6 Jo
215628	222129	β Peg	706 9.0 Mp	734 9.4 Th	708 10.3 Ah
683[13.0 En	732 13.7 L	225927	707 8.6 Jo	735 9.0 Jo	**714** 10.4 Ah
U Aqr	S Lac	769 1.8 Dg	708 9.1 Ah	739 10.2 Bo	714 10.6 Jo
215717	222439	791 2.4 Dg	711 8.8 Jo	R Aqr	**717** 10.5 Jo
685 12.3 Ch	716 13.3 L	R Peg	714 8.8 Jo	*233815*	725 11.5 Wd
712 11.5 L	720 12.6 Pt	230110	716 8.5 L	677 8.8 Ch	**731** 10.0 Jo
720 11.5 Pt	733 12.8 Mg	685 10.7 Ch	716 8.9 Th	681 9.0 Bl	**733** 10.9 B
S PsA	733 12.7 L	720 11.6 Pt	717 8.7 Th	681 8.7 En	**735** 11.4 Gy
215828	R Ind	727 11.5 Bg	720 8.6 Pt	685 9.0 En	**735** 9.9 Jo
683 12.2 En	*222867*	V Cas	729 8.1 L	688 8.9 Bl	735 10.1 Ah
RZ Peg	681 9.9 Bl	230759	731 7.9 Th	699 8.3 Bl	**737** 11.4 Wd
220133b	681 10.2 En	676 9.2 Ch	734 7.9 Th	701 8.5 Ch	Z Peg
712 11.9 L	688 11.0 Bl	705 7.8 Ch	735 8.4 Ah	706 8.4 Jo	235525
729 11.8 L	699 11.6 Bl	707 7.8 Jo	RY Cep	707 8.0 Bl	686 10.4 Ch
T Peg	704 12.2 En	708 7.7 Ah	231878	711 8.3 Jo	**716** 9.4 L
220412	707 12.5 Bl	714 7.3 Ah	706 9.8 Ch	712 8.6 L	**720** 9.5 Pt
712 12.3 L	T Tuc	720 7.5 Pt	V Phe	720 8.1 Pt	**729** 9.1 L
729 12.0 L	*223462*	725 7.6 Ko	*232746*	724 8.6 L	**731** 8.6 Jo
RS Peg	681 8.4 En	726 7.7 Ah	681 10.0 En	732 8.6 L	**735** 8.8 Gy
220714	703 9.1 En	727 7.7 Ah	685 10.0 En	Z Cas	W Cet
716 12.7 L	R Lac	731 7.7 Ko	704 10.4 En	233956	*235715*
716 12.3 B	223841	732 8.0 Sf	Z And	686 13.4 Ch	686 11.0 Ch
729 12.7 L	716 14.0 L	733 8.0 B	232848	736 14.7 L	Y Cas
R PsA	733 14.0 L	735 8.5 Jo	720 10.7 Pt	RR Cas	235855
221230	S Aqr	735 8.1 Ah	731 11.1 Hu	235053	716 12.1 L
683[12.9 En	*225120*	736 8.5 Ah	739 10.9 Bw	733 11.3 B	729 11.8 L
X Aqr	685 8.5 En	735 7.7 Ko	ST And	735 11.3 Ie	SV And
221321	RW Peg	739 8.3 Sf	233335	R Phe	235939
685[13.4 En	225914	743 8.5 Cy	676 10.5 Ch	*235150*	686 11.6 Ch
T Gru	685 10.0 Ch	750 8.9 Cy	686 10.3 Ch	681 13.0 En	**720** 9.2 Pt
221938	704 9.0 Ch	751 9.1 Sf	706 10.2 Ch	704 13.0 En	**725** 9.5 Ie
681 10.1 En	710 9.0 Jo	W Peg	714 9.5 Jo	V Cet	**733** 8.7 Mg
688 10.4 En	712 9.2 L	231425	716 9.3 Th	*235209*	**741** 8.9 B
703 11.6 En	714 9.4 Jo	685 12.1 Ch	717 9.3 Jo	686 13.4 Ch	
	721 8.8 Jo	716 12.1 L	720 9.3 Pt	707[11.7 Bl	

Rapidly Varying Irregular Variables.

Star J.D.	Est.Obs.	J.D.	Est.Obs.	Star J.D.	Est.Obs.	J.D.	Est.Obs.
005840 RX Andromedae—				060547 SS Aurigae—			
6707.2	13.1 Ch	6737.6	11.0 Pt	6721.7	14.1 L	6738.3	14.4 L
6715.4	11.2 Ry	6737.7	11.1 Wn	6722.3	14.4 L	6739.7[	13.9 Bw
6722.6	13.2 Pt	6742.6	12.8 Pt	6723.2	14.5 L	6740.6[	12.5 Cy
6732.6	13.2 Pt	6750.6	11.3 Pt	6724.3	14.4 L	6742.6[	12.6 Pt
				6725.9[	12.5 Pt	6743.7[	12.5 Cy
060547 SS Aurigae—				6729.3[	12.5 L	6746.7[	13.8 Bw
6677.1	11.2 Ch	6711.2	14.5 L	6732.6[	12.5 Pt	6747.6[	14.5 Mg
6682.1	10.8 Ch	6712.3	12.5 L	6734.3	14.4 L	6748.7[	12.5 Cy
6685.1	11.0 Ch	6716.3	12.5 L	6735.2[	11.5 L	6750.6[	12.5 Pt
6689.1	13.9 Ch	6716.6	12.9 B	6736.3	14.5 L	6751.5[	12.5 Cy
6695.4[	13.9 Ch	6720.3	14.3 L	6737.3	14.5 L		

VARIABLE STAR OBSERVATIONS RECEIVED DURING FEBRUARY, 1932.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
074922 U GEMINORUM—							213843 SS CYGNI—						
	6682.2	13.9	Ch	6735.3	13.8	L		6707.6	12.0	Jo	6732.5	8.5	Ae
	6686.2[	13.3	Ch	6735.6	13.7	B		6708.2	12.0	Ah	6732.6	8.6	Bc
	6695.5[	13.3	Ch	6736.3	13.7	L		6711.2	12.0	L	6732.6	8.5	Pt
	6707.2	13.9	Ch	6737.3	13.7	L		6711.6	11.8	Jo	6733.3	8.5	L
	6712.1[	13.7	Sl	6737.7	14.4	Wn		6712.2	11.8	L	6733.6	8.4	Mg
	6716.4	14.1	L	6738.3	14.0	L		6714.2	11.6	Ah	6733.9	8.3	Hr
	6716.6	14.0	B	6740.6	14.0	B		6714.6	11.8	Jo	6734.2	8.5	L
	6720.6[	11.8	Pt	6742.6[	12.4	Pt		6715.9	11.3	Hr	6734.5	8.4	Ae
	6721.7[	13.8	Ie	6743.7[	12.4	Cy		6716.3	11.9	L	6734.6	8.5	Bc
	6724.7	14.0	L	6747.7	13.7	Mg		6716.5	11.6	B	6734.9	8.3	Hr
	6725.9[	12.4	Pt	6748.7[	12.4	Cy		6717.6	11.6	Jo	6735.2	8.6	L
	6732.6[	12.4	Pt	6750.6[	12.4	Cy		6719.3	11.8	Ah	6735.2	8.7	Ah
	6734.6	14.0	B	6751.5[	12.4	Cy		6720.2	11.8	Ah	6735.5	8.5	Sf
	6734.6	13.9	L					6720.3	11.9	L	6735.5	8.6	B
081473 Z CAMELOPARDALIS—								6720.6	11.5	Pt	6735.6	8.6	Mg
	6711.2	13.0	L	6733.7	12.7	L		6720.6	11.7	Jo	6735.6	9.1	Pt
	6712.3	12.9	L	6734.7	12.6	L		6721.5	11.7	Wd	6735.9	8.5	Hr
	6716.3	13.0	L	6735.3	12.7	L		6721.6	11.6	Jo	6736.2	8.8	Ah
	6720.3	11.2	L	6735.6	13.4	Pt		6722.2	11.8	L	6736.2	8.6	L
	6720.6	10.6	Pt	6736.3	12.7	L		6722.3	11.8	Ah	6736.5	8.8	B
	6721.3	11.2	L	6736.7	12.9	L		6722.6	11.7	Pt	6736.9	8.6	Hr
	6722.3	11.5	L	6737.3	12.8	L		6723.2	11.8	L	6737.3	8.7	L
	6722.6	10.9	Pt	6737.7	13.0	L		6724.2	12.0	L	6737.5	8.4	Sf
	6723.2	11.7	L	6737.7	12.5	Wn		6725.2	10.0	L	6737.5	8.9	Wy
	6724.2	12.1	L	6738.3	12.1	L		6725.5	9.6	Wd	6737.5	8.3	Cy
	6725.7	12.6	Hu	6738.5	11.0	Me		6725.5	9.8	Ie	6737.5	8.7	Ae
	6725.9	12.3	Pt	6738.8	11.4	Pt		6725.6	9.5	Jo	6737.6	9.0	Pt
	6729.3	12.5	L	6742.6	10.5	Pt		6725.7	9.7	Hu	6737.6	8.5	Bc
	6732.3	12.7	L	6743.6	11.4	Me		6725.9	9.5	Pt	6737.7	8.7	L
	6732.6	13.4	Pt					6726.4	9.1	Ah	6738.2	8.7	L
094512 X LEONIS—								6726.7	9.4	L	6738.5	8.7	Ae
	6722.8[	14.5	Al	6738.8[	13.0	Pt		6727.3	8.9	Ah	6738.5	8.6	Cy
202946 SZ CYGNI—								6727.5	9.3	Wd	6738.5	9.0	Me
	6720.5	9.0	Pt	6735.6	8.9	Pt		6727.5	9.0	Bg	6739.5	9.2	Ie
	6722.6	9.2	Pt	6737.6	9.2	Pt		6728.2	8.9	Ah	6839.5	9.0	Sf
	6725.9	9.7	Pt	6742.6	9.2	Pt		6729.2	8.7	L	6839.5	8.9	Ae
	6732.6	8.8	Pt	6750.6	9.2	Pt		6729.3	8.7	Ah	6741.5	9.3	Ae
213843 SS CYGNI—								6730.2	8.6	L	6741.5	9.8	B
	6649.9	11.8	Hr	6682.1	11.7	Ch		6731.5	8.9	Me	6742.6	10.5	Pt
	6652.9	12.0	Hr	6686.1	11.6	Ch		6731.6	8.6	Wd	6743.5	10.0	Ae
	6656.0	11.5	Hr	6696.1	11.9	Ch		6731.7	9.6	Hu	6746.5	11.4	Ae
	6673.1	8.8	Ch	6705.1	11.7	Ch		6732.3	8.7	L	6750.6	11.7	Pt
	6680.0	11.3	Hr	6706.6	12.0	Jo		6732.5	8.4	Sf	6751.6	11.2	Cy

SUMMARY FOR THE MONTH OF FEBRUARY, 1932.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	42	171	Cilley	Cy	20	50
Allen, L. B.	Ae	1	8	Darling	Dg	5	18
Baldwin	Bl	65	130	Ensor	En	70	132
Bigelow	Bw	16	21	Godfrey Club	GD	3	8
Boutell	Bo	11	63	Gregory	Gy	20	20
Bouton	B	55	70	Hildom, A.	Hi	3	4
Buckstaff	Bc	1	3	Hildom, L.	Hl	3	4
Bunting	Bg	6	6	Houston	Hu	10	18
Chandra	Ch	155	243	Hurahata	Hr	5	29

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Iedema	Ie	11	12	Peltier	Pt	168	225
Jones	Jo	72	327	Roach	Ro	4	4
Kanamori	Km	2	16	deRoy	Ry	5	15
Kohman	Ko	11	29	Shinkfield	Sl	29	64
Lacchini	L	165	419	Shultz	Sz	5	5
Marsh	Ma	25	26	Smith, F. W.	Sf	13	32
McLeod	Mc	10	17	Smith, L.	Sh	7	23
McPherson	Mp	8	10	Theile	Th	11	30
Meek	Me	8	13	Webb	Wd	18	55
Monnig	Mg	28	29	Whitney	Wy	22	22
Olivier	Ol	6	6	Wilson	Wn	30	30
O'Byrne	Oy	4	6				
				Totals	41	421	2413

The Association headquarters are now permanently relocated in what was formerly the main library of the Harvard Observatory. The same room serves as the office of the Recorder, and here are deposited the A.A.V.S.O. Library, slide collection, and original variable star reports. A large framed oil painting of Professor Pickering, founder of the Association, adorns the west wall of the room. Adequate space is now provided for all present and future needs of the Association at the headquarters at Harvard.

The Spring Meeting of the Association is to be held May 7 at Hood College, Frederick, Maryland.

LEON CAMPBELL, Recorder.

March 10, 1932.

Zodiacal Light Notes

By W. E. GLANVILLE

Slow recovery from sickness has made observations impossible since the last report, except on the following dates: Evening: January 31, February 1, 3, 23, 26, 27, 29, March 1. Morning: February 13. Gegenschein, March 1.

EVENING ZODIACAL LIGHT. On January 31, February 1 and 3 at 7:30 each evening the Light extended from the horizon in Aquarius through Pisces to Aries; the north boundary covered Alpha and Gamma Pegasi; the south boundary passed about three degrees north of Delta Aquarii.

The apex was blunted and pointed towards the Pleiades. The intensity of the Light was much less than that of the Milky Way area from Cygnus to Aquila. On February 23 from 7:20 to 7:35 the Light extended, near the horizon, about five degrees north of Zeta, Theta, and Eta Ceti across to the Square of Pegasus, two-thirds of which was covered. From about three degrees south of the Aries asterism it narrowed towards the Pleiades, the blunt apex pointing directly to that cluster. On February 26 at 7:30 it spread somewhat north of the ecliptic, Beta and Gamma Arietis being on the north edge. The Pleiades were covered. Beyond the Milky Way in Taurus no trace could be seen. On February 27 at 9:30 the Aries group was covered. Earlier in the evening clouds prevented a satisfactory observation. On February 29 and March 1 special attention was given to the departure of normal twilight which disappeared first from the south of the Zodiac and later from the north until the Zodiacal Light area was established. The Light was extremely faint on both evenings.

MORNING ZODIACAL LIGHT. On February 13 at 5:00 A.M. the Light was very faint from the head of Scorpio to Libra beyond which constellation it could not be seen. It filled the space between Alpha and Beta Librae. From the head of Scorpio to the horizon it was invisible on account of the Milky Way then skirting the horizon from Scutum to Cygnus and Cassiopeia.

GEGENSCHEIN. On March 1 at 8:00 P.M. the Gegenschein was observed towards the eastern part of Leo Major. It was exceedingly faint, with no connecting Zodiacal bands east or west. Dimensions were estimated as ten degrees along the ecliptic and eight degrees for minor diameter.

A correspondent asks: "Is it true that the Zodiacal Light is generally brighter during the maximum phase of the sunspot period than during the minimum phase?" Yes, according to the reports of experienced observers. During the present season, for example, it has not been possible to trace the evening Light beyond the Milky Way in this latitude. Why this condition exists is a question which, so far as the writer is aware, has not been specially studied. The suggestion has been offered that the varying altitude of the Kennelly-Heaviside layer may be connected with this periodic difference in Zodiacal Light luminosity. It is known that at sunspot maximum the Kennelly-Heaviside layer is lower than at sunspot minimum. Whether the average difference in solar radiation as between the maximum and minimum phases of the sunspot period would altogether account for the varying Zodiacal Light at those phases is also a question.

The Rectory, New Market, Maryland.

General Notes

Dr. Robert G. Aitken, director of the Lick Observatory, will deliver the George Darwin lecture before the Royal Astronomical Society on May 13. On this occasion, Dr. Aitken will receive the gold medal of the Royal Astronomical Society which has been awarded to him for his extensive and fruitful work in the field of double-star astronomy.

The Observatory of Athens.—Professor D. Eginitis, the director of this observatory, has recently published the results of a series of observations made for determined definitively the longitude of the observatory. On the basis of a comparison of 2595 signals during the interval from 1923 to 1930, he has concluded that the longitude of the Observatory of Athens is $1^h\,34^m\,52^s.065$ east of Greenwich.

Amateur Astronomy in the Northwest.—The *Scientific American* for February, 1932, gives a two page display showing results of activity among amateurs in the state of Washington. The interest is principally in the making of reflecting telescopes. Ten photographs of telescopes and their makers are shown. These and nine others formed an exhibit by invitation at the Western Washington State Fair at Puyallup recently. It attracted much attention and it is estimated that approximately 100,000 persons visited the exhibit. Amateur astronomy seems to be becoming increasingly popular as a hobby.

Irving Langmuir, research chemist and physicist, and associate director of the Research Laboratories of the General Electric Company, at Schenectady, New

York, is this year's winner of the *Popular Science Monthly* Annual Award of $10,000 for notable scientific achievement.

Announcement to that effect was made recently by Raymond J. Brown, editor of *Popular Science Monthly*, who stated Dr. Langmuir was singled out for the distinction from hundreds of candidates in recognition of his numerous contributions to pure and applied science, among which his inventions of the nitrogen-filled incandescent electric light bulb and the atomic welding arc are conspicuous. The award, together with a gold medal commemorating it, was presented to Dr. Langmuir on February 29 in New York City.

The *Popular Science Monthly* Award, largest prize for scientific accomplishment in the United States, was established two years ago for the double purpose of honoring Americans who have done notable scientific work and of stimulating the public mind to a greater appreciation of the values of scientific investigation. The first winners were Dr. George H. Whipple, of the University of Rochester, and Dr. George R. Minot, of Harvard University, who received the award jointly last year for their discovery and development of a cure for pernicious anemia.

Note on 13 Mu Sagittarii and Two Other, Possibly Similar, Stars

In the February, 1932, issue of POPULAR ASTRONOMY there appeared a short note by the writer, reporting on a search made for the massive white dwarfs required by the Atkinson theory of stellar energy. In this note it was stated that 29 Canis Majoris was the only star found of this class. The writer recently secured a copy of Schlesinger's "Catalog of Bright Stars," and, using the parallaxes given in that work, re-examined his lists of spectroscopic binaries. In the course of this work it was found that the star 13 μ Sagittarii showed an abnormality in the same direction as 29 Canis Majoris, though not so marked in extent. Schlesinger gives the apparent visual magnitude of this star as 4.01, and its parallax as 0".012. This makes its absolute magnitude —0.59; the spectrum is B8p (CB8), and the mass function is 3.63 (W. W. Campbell, "Stellar Motions"). Assuming the inclination of the orbit to the plane of the sky to be 70° and the fainter star to have one-half the mass of the brighter one, the masses of the two stars come out 78 and 39 times sun. A spectrum of class B8 corresponds to a surface temperature of 12,000° C. Using the same formulae and methods as were used on page 120, vol. 40, POPULAR ASTRONOMY, it is found that the star should have an absolute magnitude of —6.8 on the writer's assumptions, if it follows the mass-luminosity law, and that the density is 5,400 times that of a normal star of the same mass and surface temperature. It is apparently in an intermediate stage between the massive white dwarfs and the normal super-giant stars. At first sight the character of the spectrum may seem to be an obstacle to the writer's theory but the sun and some other dwarf stars have spectral lines as narrow as those which occur in the spectra of the c stars. (See Miss Payne's "Stars of High Luminosity," pages 55 and 174.)

Two other stars, for which the data are incomplete, but which should possibly be regarded as similar in character to μ Sagittarii and 29 Canis Majoris are 18 ρ Geminorum and "Struve's Star," 27 Canis Majoris.

For the first star the evidence is as follows. Schlesinger gives the apparent magnitude as 4.06 and the parallax as 0".013; which corresponds to an absolute magnitude of —0.37. Yet, the value of the mass function, which is unavailable to the author, is so high that Miss Payne included the star in her list of spectro-

scopic binaries of high mass on page 51 of the "Stars of High Luminosity." The spectrum is B5.

The case of 27 Canis Majoris, Boss 1872, is stranger still. From observations extending over a number of years, Otto Struve of Yerkes Observatory deduced for this star the enormous mass function of 275 times sun. The star may be a variable of small range. (See pages 301-307, vol. 73, *Astrophysical Journal.*) Struve considers the system as probably triple. Schlesinger gives the apparent magnitude as 4.66 but does not give any parallax. However, the annual proper motion is 0".0076. This shows that 27 Canis Majoris is not an especially remote star. But a fifth magnitude star of the mass of 27 Canis Majoris would have to be so remote as to show no proper motion, if it followed the mass-luminosity law. The spectrum of 27 Canis Majoris is B5p.

Recently, however, Dean B. McLaughlin published a note (page 60, vol. 75, *Astrophysical Journal*) giving reasons why Struve's orbit and mass function are open to doubt. McLaughlin considers the star to be a normal Be star with a variable spectrum. The difficulty with this theory lies in the fact that in 27 Canis Majoris the helium lines show the same Doppler shifts as the hydrogen lines.

Noah W. McLeod.

Christine, North Dakota.

Book Reviews

Handbuch der Astrophysik, Band 2, Zweite Hälfte, Grundlagen der Astrophysik, zweiter Teil. (Julius Springer, Berlin, 1931. 316 pp. Price 45.75 marks.)

This volume of the *Handbuch der Astrophysik* deals with photometry. The first part, by Professor G. Eberhard of Potsdam, is devoted to photographic photometry. He discusses the photographic plate and its characteristics; methods of measurement of photographic images; the various photometric methods of King, Kapteyn-Wirz, Schwarzschild, Hertzsprung as well as the method of simple diaphragms; methods of determining the opacity curve; the various corrections to the measured opacity; atmospheric extinction; methods of measuring great differences in intensity of light sources; the comparison of various photometric catalogs with the north polar sequence and photographic spectro-photometry.

The second part, by Professor W. Hassenstein of Potsdam, deals with visual photometry. It involves a discussion of the fundamental concepts and principles of visual photometry based on physiological optics; the refractor as a photometric auxiliary; methods of measuring light intensities and means of reducing such intensities; the method of extinction; the equivalence method; the methods of magnitude estimates and the step method.

Each part is followed by a reasonably comprehensive bibliography in addition to copious references to original papers as footnotes. The volume should be of great value to workers in photographic or visual photometry and will no doubt partially replace Müller's treatise on the subject. —E.A.F.

The Ingenious Dr. Franklin, edited by Nathan G. Goodman. (University of Pennsylvania Press, Philadelphia, Pa. Price $3.00.)

This volume of 240 pages consists of letters written by Benjamin Franklin to certain of his friends on a variety of subjects. One who is not familiar with

the unusual genius of this person will not at once see the appropriateness of the title of the book, but as one reads these letters and finds his interest in them aroused more and more both by their content and by their style, he is impressed with the peculiar fitness of it.

The wide range of intelligent interest on the part of the writer of the letters is indeed astonishing. To mention only a few, in this connection are to be found letters on the following topics: Daylight Saving, Electrical Treatment for Paralysis, Pennsylvania Fireplaces, Learning to Swim, Balloon Ascensions, Magic Squares, Locating the Gulf Stream, Cold by Evaporation, Sun Spots, Toads Found in Stone. Each of these topics and many others are treated in a masterful way, and the reader is convinced that the writer is thoroughly conversant with the subject under consideration.

In the period of a century and a half which has elapsed since these letters were written, scientific investigations have brought into clear light some of the aspects of the several subjects which were puzzling and obscure to Dr. Franklin, but it is doubtful whether any one had a more thorough grasp of the facts then available than he. Moreover, the presentation is made in a clear and fluent style which in itself makes a reading of the volume a pleasure.

In one of these letters Dr. Franklin describes an experiment by which some flies which were seemingly drowned in Madeira wine were resuscitated by being exposed to the rays of the sun. He then expresses the wish that this treatment might be efficacious in the case of human beings also. ". . . for having a very ardent desire to see and observe the state of America a hundred years hence, I should prefer to any ordinary death the being immersed in a cask of Madeira wine, with a few friends, till that time, to be then recalled to life by the solar warmth of my dear country!" In another letter, while describing a balloon ascension, he predicts that balloons may sometime be used in war for invading enemy territory. If his wish could have been fulfilled, how great would have been his surprise at the extent to which his prophecy has been realized!

The volume can be highly recommended as entertaining, instructive, and inspiring.

Relativitätstheorie, by Professor L. Hopf; and **Wetter und Wetterentwicklung,** by Dr. H. von Ficker. (Julius Springer, Publisher, Berlin. 4.80 marks each.)

These two books, although treating widely different phases of science are mentioned together here because they are number 14 and number 15, respectively, in a series of volumes, by the publisher mentioned, which are described as containing intelligible science. A project of this kind indicates that the popular interest in science is characteristic of practically all intelligent people the world over.

However, since the German scientists have been leaders in many fields, it might be expected that a scientific consciousness would pervade the entire population. Especially would it seem natural that the former of these two volumes would have a cordial reception in Germany. But science has so completely disregarded national boundaries that a book of merit is well received everywhere.

Those, who are not hampered by the fact that these books are in the German language, will find them interesting, thorough, and authentic.